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UPPER BAKER PROJECT, SKAGIT RIVER BASIN, WASHINGTON

COMMUNICATION

FROM

FROM THE ACTING ASSISTANT SECRETARY OF THE ARMY

TRANSMITTING

A CORPS OF ENGINEERS REPORT ON THE UPPER BAKER PROJECT, SKAGIT RIVER BASIN, WASHINGTON, PURSUANT TO SECTION 209 OF THE FLOOD CONTROL ACT OF 1962

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WASHINGTON : 1977

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

May 5, 1977

Honorable Thomas P. O'Neill
Speaker of the House of Representatives
Washington, D. C. 20515

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 10 September 1976 from the Chief of Engineers, Department of the Army, on Upper Baker Project, Skagit River Basin, Washington, together with other pertinent reports. The report has been prepared in response to Section 209 of the Flood Control Act of 1962, Public Law 87-874.

The views of the State of Washington, the Departments of Interior, Agriculture, Transportation, Health, Education, and Welfare, and Commerce, the Environmental Protection Agency, and the Federal Power Commission are set forth in the inclosed communications, together with the reply of the Chief of Engineers to the Secretary of Commerce. The environmental impact statement required by the National Environmental Policy Act of 1969 has been submitted to the Council on Environmental Quality.

Since this project meets all the requirements of Section 201 of the Flood Control Act of 1965 and involves little or no controversy, I recommend that the project be approved for appropriations.

The Office of Management and Budget advises that there is no objection to the submission of the Chief of Engineers report to the Congress; however, it states that no commitment can be made at this time as to when any estimate

of appropriation would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. A copy of the letter from the Office of Management and Budget is inclosed as part of the report.

Sincerely,

Charles R. Ford

1 Incl
As stated

Charles R. Ford
Acting Assistant Secretary of the Army
(Civil Works)

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

29 April 1977

Honorable Clifford Alexander
Secretary of the Army
Washington, D.C. 20310

Dear Mr. Secretary:

Assistant Secretary Victor V. Veysey's letter of December 13, 1976, submitted a report of the Chief of Engineers on Upper Baker Project, Skagit River Basin, Washington, and requested advice as to its relationship to the program of the President, pursuant to Executive Order No. 9384, dated October 4, 1943.

There would be no objection to the submission of this report to the Congress. No commitment, however, can be made at this time as to when any estimate of appropriations would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then-prevailing fiscal situation.

Sincerely yours,

THOMAS KERTRAM LANCE
DIRECTOR

COMMENTS OF THE STATE OF WASHINGTON

State of
Washington
Department
of Ecology

June 9, 1976

Lieutenant General W. C. Gribble, Jr.
Chief Engineer
Office of Chief Engineer
U. S. Army Corps of Engineers
Washington D. C. 20314

Dear General Gribble:

In reference to your letter dated March 3, 1976, (78-534), we have reviewed the Authorization Report and the Revised Environmental Statement for the Upper Baker Project, Skagit River Basin, and concur with the findings and recommendations contained therein.

We, therefore, encourage early implementation of Flood Plain Management with additional flood control storage at the Upper Baker Project.

Sincerely,

John A. Biggs, Director

JAB:sm

cc: Washington Congressional Delegation
Senator Jennings Randolph

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/237

8 June 1976

Dear General Gribble:

Thank you for the letter of March 3, 1976, requesting our views and comments on the revised draft environmental statement and authorization report for Upper Baker Project, Skagit River Basin, Skagit and Whatcom Counties, Washington. We have reviewed the documents and conclude that they adequately consider those areas within our jurisdiction and expertise, except for several suggestions offered below.

Environmental Statement

Inasmuch as the additional drawdown of Baker Lake Reservoir will occur during the typically wet month of November, the frequency and magnitude of flooding that may occur locally on Baker River below the dam should be assessed.

The statement should discuss at least in general terms the downstream changes in ground-water levels and in ground-water/surface-water inter-relationships that can be anticipated as a result of the changes in storage and release patterns at the reservoir. Examination of the proportion of the Skagit River flows contributed by Baker River suggests that it is significant and related effects on ground water should be noticeable.

We are pleased to note that our comments on the first draft statement have been satisfactorily addressed in the revised document.

Authorization Report

We find that the information contained in the document accurately describes the recommended plan, alternative plans, and other project features. The data and recommendations conform with our previous understanding of the project.

We conclude that change in operation of the Upper Baker Project will minimize adverse effects on fish and wildlife and should provide additional protection for wildlife resources utilizing the Skagit River flood plain downstream from the project.

Accordingly, we do not object to the Report of the Chief of Engineers recommending that the project be operated as proposed to provide additional flood control storage space.

Sincerely yours,

Stanley R. Doremus

Deputy Assistant Secretary of the Interior

W. C. Gribble, Jr.
Lieutenant General, USA
Chief of Engineers
Department of the Army
Washington, D. C. 20314

COMMENTS OF THE DEPARTMENT OF AGRICULTURE

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

2 June 1976

Lt. General W. C. Gribble, Jr.
Chief of Engineers
Office of the Chief of Engineers
Department of the Army

Dear General Gribble:

This is in response to your letter of March 3, 1976, to Secretary Butz transmitting for our review and comments your proposed report with pertinent papers and a revised draft environmental impact statement for the Upper Baker Project, Skagit River Basin, Washington.

We have reviewed the report and have three comments for your consideration:

1. It would be desirable to include more detail in the discussion of agricultural flood damages in appendix 1, section P. Some data on land use, yields and production with and without the plan would give local people, planners, and researchers a better understanding of plan impacts on agriculture.

2. Footnote 5, table 1, p.33, should be rewritten to make it clear that the same benefits were not counted twice for alternative 2, once as flood damages prevented and again as reduction in flood insurance payments.

3. A full reference should be given for the study by Resources for the Future, Inc., mentioned on p. F-17.

The revised environmental impact statement includes responses to comments made by our state conservationist on the February 26, 1975, draft. We have no further substantive comments.

Thank you for providing this report and environmental impact statement for our review.

Sincerely,

ROBERT W. LONG
Assistant Secretary

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

July 16, 1976

Colonel John A. Poteat
Assistant Director of
Civil Works Pacific
Department of the Army
Office of the Chief of Engineers
Washington, D. C. 20314

Dear Colonel Poteat:

This is to acknowledge the arrangements discussed between Mr. Joe Auburg of your office and Mr. Ed Wilczynski of my staff on July 16, 1976, confirming your agreement to extend the Department of Commerce comment period for 21 days on the "Upper Baker Project, Skagit River Basin, Washington." We will look forward to receiving the six (6) copies of the report which we requested so that an expedient response can be initiated.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Policy
Washington, D.C. 20230

6 August 1976

John A. Poteat
Colonel, Corps of Engineers
Department of the Army
Office of the Chief of Engineers
Washington, D.C. 20314

Dear Colonel Poteat:

Secretary Richardson has asked me to reply to you concerning the Department of Commerce comments on the Corps of Engineers' authorization report for additional floor control at Upper Baker Project, Skagit River Basin, Washington.

We appreciated the extension of the review period that you granted and we will make every effort in the future to see that such extensions are not necessary.

Overall, the departmental comments were favorable on the report. However, some technical questions were raised which I have summarized and enclosed with this letter.

Thank you for the opportunity to make these comments.

Sincerely,

Robert S. Milligan

Robert S. Milligan
Deputy Assistant Secretary
for Policy Development
and Coordination

Enclosure

Office of Regional Economic Coordination

The proposed plan seems to be properly justified.

On p. 22, it is claimed that the expected flood damages will average $4,246,000 annually (1974 prices). Yet, on the previous page, a table of historical flood damages for the past 55 years provides data that indicate an average annual flood loss of $3,000,000 (in 1973 prices). Some explanation should be given of why the 1974-price loss level is so much above the historical figure. Note that Appendix 1 (pp. F-4 to F-20) explains in some detail how that $4,246,000 annual figure is derived. But this discussion did not recognize or attempt to reconcile the difference from the historical annual loss values.

National Oceanic and Atmospheric Administration
National Weather Service

The Office of Hydrology made the following comments:

On page 18, under the heading "Status of Existing Plans and Improvements," the following statement should be included: "The River and Flood Forecast and Warning program of the National Oceanic and Atmospheric Administration presently provides flood forecasts and warnings for the communities of Concrete and Mt. Vernon."

On page 42, under the heading "Selected Plan Description," the following statement should be included as item f: "Flood forecasts and warnings provided by the National Oceanic and Atmospheric Administration's National Weather Service."

On page 50, under the heading "Division of Plan Responsibilities," the following sentence should be added to the first paragraph: "The National Oceanic and Atmospheric Administration will continue to provide flood forecasts and warnings for the Skagit River Basin as required."

National Marine Fisheries Service

The Corps of Engineers Authorization Report for Additional Flood Control at Upper Baker Project, Skagit River, Washington was discussed with State and Federal agencies. A prior review of the project completed in May-June 1974, indicated a concern about sockeye salmon redd dewatering in Baker Lake. NMFS recommended that flood control drawdown commence one day after Labor Day and be completed by October 1. This plan would deter adults from spawning at higher elevations and subsequent redds from being dewatered.

The Corps of Engineers in response to this plan, indicated that sockeye salmon redds are dewatered under present Baker Dam operations and that the proposal for additional flood control storage had the potential of reducing redd losses by limiting the occurrence of spawning in areas that become dry every year. The Corps also stated that "the FPC license is specific as to the provision for additional flood control."

Additionally, NMFS recommended that "to maximize a deterrent to sockeye beach spawning within the October 1 to November 15 time frame, the drawdown be made at a constant rate in terms of reservoir elevation during this period."

NMFS plans no further action at this time, but will continue coordination with State and Federal fishery agencies if needed.

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-CWP-W

September 10, 1976

Mr. Robert S. Milligan
Deputy Assistant Secretary
for Policy Development
Department of Commerce
Washington, D. C. 20230

Dear Mr. Milligan:

Your letter of 6 August 1976, commenting on our Authorization Report for Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington, is appreciated. Our response to your comments is inclosed.

Sincerely yours,

(SIGNED)

1 Incl
As stated

R. C. MARSHALL
Major General, USA
Acting Chief of Engineers

3 September 1976

Response to U.S. Dapartment of Commerce comments on Authorization Report for Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington

Comment 1 - "The proposed plan seems to be properly justified. On p. 22, it is claimed that the expected flood damages will average $4,246,000 annually (1974 prices). Yet, on the previous page, a table of historical flood damages for the past 55 years provides data that indicate an average annual flood loss of $3,000,000 (in 1973 prices). Some explanation should be given of why the 1974-price loss level is so much above the historical figure. Note that Appendix 1 (pp. F-4 to F-20) explains in some detail how that $4,246,000 annual figure is derived. But this discussion did not recognize or attempt to reconcile the difference from the historical annual loss values."

Response: Historical flood damages shown on page 21 are only for the larger floods. Damages associated with the smaller, more frequent floods, are not listed. (This would account for the difference between historical annual loss computed by the Office of Regional Economic Coordination and the average annual damages shown on page 22.) If historical average annual losses were used, damages associated with all floods above zero damage discharge would have to be evaluated following each occurrence. This would require considerable effort and expenditure of funds when all river basins are considered. The method reflected in this report, discussed in Appendix 1 (pages F-13 to F-20), is the standard approach used in all Corps of Engineers damage assessment.

Comment 2 - a. "On page 18, under the heading Status of Existing Plans and Improvements, the following statement should be included: 'The River and Flood Forecast and Warning program of the National Oceanic and Atmospheric Administration presently provides flood forecasts and warnings for the communities of Concrete and Mt. Vernon.'"

b. "On page 42, under the heading Selected Plan Description, the following statement should be included as item f: 'Flood forecasts and warnings provided by the National Oceanic and Atmospheric Administration's National Weather Service.'"

c." On page 50, under the heading Division of Plan Responsibilities, the following sentence should be added to the first paragraph: 'The National Oceanic and Atmospheric Administration will continue to provide flood forecasts and warnings for the Skagit River Basin as required.'"

89-260 O - 77 - 2

Response: Comments by the National Oceanic and Atmospheric Administration, National Weather Service, Office of Hydrology, are noted.

Comment 3 - a. "The Corps of Engineers Authorization Report for Additional Flood Control at Upper Baker Project, Skagit River, Washington was discussed with State and Federal agencies. A prior review of the project completed in May-June 1974, indicated a concern about sockeye salmon redd dewatering in Baker Lake. NMFS recommended that flood control drawdown commence one day after Labor Day and be completed by October 1. This plan would deter adults from spawning at higher elevations and subsequent redds from being dewatered."

b. "The Corps of Engineers in response to this plan, indicated that sockeye salmon redds are dewatered under present Baker Dam operations and that the proposal for additional flood control storage had the potential of reducing redd losses by limiting the occurrence of spawning in areas that become dry every year. The Corps also stated that 'the FPC license is specific as to the provision for additional flood control.'"

c. "Additionally, NMFS recommended that 'to maximize a deterrent to sockeye beach spawning within the October 1 to November 15 time frame, the drawdown be made at a constant rate in terms of reservoir elevation during this period.'"

d. "NMFS plans no further action at this time, but will continue coordination with State and Federal fishery agencies if needed."

Response: The National Marine Fisheries Service discussion of study coordination as it relates to the sockeye fishery resource in Baker Lake is accurate. We note and share their concern for this resource and will coordinate with appropriate entities,within the limits of our authorities, to assure maximum possible protection of the fishery.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS
U.S. COAST GUARD (G-WS/73)
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

3 June 1976

Lieutenant General W. C. Gribble, Jr.
Chief of Engineers
Department of the Army
Washington, D. C. 20314

Dear General Gribble:

This is in response to your letter of 3 March 1976 addressed to Secretary Coleman concerning a revised environmental impact statement on the Upper Baker Project, Skagit River Basin, Skagit County, Washington.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

[illegible]
Assistant Commandant for Marine
Environment and Systems

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

6 May 1976

Lieutenant General W. C. Gribble, Jr.
Chief of Engineers
Department of the Army
Washington, D.C. 20314

Reference: DAEN-CWP-A

Dear General Gribble:

This is in reply to your letter of March 3, 1976, inviting comments by the Commission relative to your proposed report and to the reports of the Board of Engineers for Rivers and Harbors and of the District and Division Engineers on additional flood control at the Upper Baker project, Skagit River Basin, Washington. A revised draft environmental impact statement accompanied the reports.

The cited reports recommend modification in the operation of the existing Upper Baker project, owned and operated by the Puget Sound Power and Light Company, to provide 58,000 acre-feet of additional flood control storage capacity on a seasonal basis. The estimated annual flood damage reduction benefits are $1,127,000, and the estimated annual economic costs, consisting for the most part of the value of power (capacity and energy) losses, are $434,000. The Puget Sound Power and Light Company would be compensated with power, in kind, from the existing Federal power system. The Bonneville Power Administration estimated the annual cost of replacement power at $56,000.

The Commission staff has reviewed the economics of the proposal. Using a range of power values generally applicable to the Pacific Northwest and the Company's estimate of power losses, 6,300 kilowatts of dependable capacity and 1,117 kilowatts of average energy, the staff analysis indicates that the $1,127,000 annual flood control benefits estimated by your Department would substantially exceed the value of

the power lost and also far exceed the cost of replacement power generated within the Federal system. Consequently, it is apparent that the proposal would be economically justified by a wide margin.

As discussed in the material furnished, the Upper Baker project is licensed by the Federal Power Commission as part of Project No. 2150. Article 32 of the license specifies that 16,000 acre-feet of flood control storage capacity will be provided in the Upper Baker Reservoir as replacement for the valley storage eliminated by the development. Article 32 further states that: "In addition to the above-specified 16,000 acre-feet, the licensee shall provide in the Upper Baker River Reservoir space for flood control during the storage drawdown season (about September 1 to April 15) up to a maximum of 84,000 acre-feet as may be requested by the District Engineer, provided that suitable arrangements shall have been made to compensate the licensee for the reservation of flood control space other than the 16,000 acre-feet specified herein." According to the reports of your Department, the licensee and the Bonneville Power Administration have generally agreed to the concept of reimbursement.

Based on its consideration of the reports of your Department, the draft environmental impact statement, and the studies of its own staff, the Commission concludes that the proposed modification in operation of the Upper Baker project would be economically justified, and that the proposals for modification and for the compensation to the project owner therefor are consistent with the project's Federal Power Commission license conditions.

Sincerely yours,

Richard L. Dunham
Chairman

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

AUG 19 1976

Lieutenant General John W. Morris
Chief of Engineers
U.S. Army Corps of Engineers
Forrestal Building
Washington, D.C. 20314

Dear General Morris:

Thank you for your request concerning our response to the Upper Baker Project, Skagit River Basin, Washington and the Lower Snake River Fish and Wildlife Compensation Plan, Lower Snake River, Washington. The Department has not reviewed these documents and, to my knowledge, does not plan to review them.

Sincerely,

Paul Cromwell
Acting Director
Office of Environmental Affairs

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: 10FA - M/S 623

April 20, 1976

Colonel Marvin W. Rees
Executive Director of Civil Works
Department of the Army
Office of the Chief of Engineers
Washington, D. C. 20314

Dear Colonel Rees:

We have reviewed the revised draft environmental impact statement prepared by the U.S. Army Corps of Engineers on Upper Baker Project, together with our original comments of April 9, 1975 on this project, and find that our original conclusion that the proposal would result in no significant environmental impacts remains unchanged.

Our comments on this revised draft statement have been classified LO-1, LO (Lack of Objections) 1 (Adequate Information). The classification of the Environmental Protection Agency's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act.

Thank you for the opportunity to review and comment on this revised draft statement.

Sincerely yours,

Francine K. Duncan

Francine K. Duncan
Acting Director
Office of Federal Affairs

UPPER BAKER PROJECT, SKAGIT RIVER BASIN, WASHINGTON

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-CWP-A

10 September 1976

SUBJECT: Upper Baker Project, Skagit River Basin, Washington

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report for Upper Baker Project, Skagit River Basin, Washington, accompanied by the report of the Board of Engineers for Rivers and Harbors, and the reports of the District and Division Engineers. These reports are in response to Section 209 of the Flood Control Act of 1962, which requested the Secretary of the Army cause to be made, under the direction of the Chief of Engineers, a survey of Puget Sound, Washington, and adjacent waters, including tributaries, in the interest of flood control, navigation, and other water uses and related land resources.

2. The District and Division Engineers recommend that the Upper Baker Project be operated to provide additional flood control storage space, and that Puget Sound Power and Light Company be compensated by the Federal Government with power, in kind, for resulting power losses. Based on July 1974 prices, a 100-year period of economic analysis and an interest rate of 5-7/8 percent, average annual charges are estimated at $434,000. Average annual benefits are estimated at $1,127,000, and the benefit-cost ratio is 2.6.

3. The Board of Engineers for Rivers and Harbors concurs generally in the findings of the reporting officers and recommends change in operation of the Upper Baker Project with Federal compensation for power losses in accordance with the plan of the District Engineer, subject to certain requirements of local cooperation.

4. The project remains highly justified under 1976 prices and an interest rate of 6-1/8 percent. Under these conditions average annual benefits are $1,309,000, annual charges are $608,000, and the benefit-cost ratio is 2.2.

5. I concur in the views and recommendations of the Board.

R. C. MARSHALL
Major General, USA
Acting Chief of Engineers

DAEN-BR (1 July 75) 2d Ind
SUBJECT: Authorization Report for Additional Flood Control at Upper Baker Project

Board of Engineers for Rivers and Harbors, Fort Belvoir, Virginia 22060
7 October 1975

TO: Chief of Engineers, Department of the Army

1. Description. --The Skagit River Basin is situated in the northwest corner of the State of Washington and drains an area of 3,140 square miles. It lies between the Cascade Mountains and Puget Sound. The northernmost end of the basin extends 28 miles into British Columbia, Canada, where it borders the Frazier River Basin. The Skagit River flood plain, from the mouth of the Baker River downstream to Puget Sound, encompasses 99,450 acres and includes portions of the towns of Mount Vernon, Burlington, Sedro Woolley, La Conner, and other smaller rural communities. The delta of the Samish River is part of the Skagit River flood plain and is included in the study area. The town of Sedro Woolley marks the transition of the flood plain from mostly narrow river-bottom land upstream, to fertile delta land downstream.

2. Economic development. --About 92 percent of the total land in the Skagit-Samish River Basins is utilized for forest production, with agricultural, urban, and other uses amounting to 5, 1, and 2 percent, respectively. The Skagit Basin is rich in natural resources with the river and its tributaries used for recreation, fish and wildlife production, hydroelectric power generation, irrigation, and municipal and industrial water supply. Considerable logging, which is very important to Skagit County's economy, takes place in the upper watershed. The Skagit River is an important contributor to the Puget Sound commercial and sport fisheries. Chinook, silver, sockeye, chum, pink salmon, and steelhead trout spawn in its waters. Although forestry and agriculture are expected to remain as the controlling factors influencing the county's economic activity, their relative importance is expected to decline as economic expansion gradually forces the transfer of land to urban use. The 1970 population of Skagit County of 52,400 has been projected to reach 66,400 by the year 2000. Mount Vernon is the largest community within the basin with a 1970 population of 8,800.

3. Existing or authorized improvements. --Skagit County has adopted flood plain regulations and has qualified for the National Flood Insurance Program pursuant to the Flood Disaster Act of 1973. Two Federal flood control projects have been authorized for the Skagit River Basin. The Avon Bypass Channel was authorized by the 1936 Flood Control Act, and levee and channel improvements downstream of Burlington were authorized by the 1966 Flood Control Act. These projects have not been constructed.

Non-Federal development includes three hydroelectric power dams on the main Skagit River and two power dams on Baker River, a tributary to the Skagit River. Two of these dams, Ross and Upper Baker, provide for flood control storage. Ross Dam, on the Skagit River, has 120,000 acre-feet of storage reserved for flood control. Upper Baker Project has 16,000 acre-feet reserved flood control storage which offsets loss of natural valley storage. Article 32 of the Federal Power Commission license for the Upper Baker Project, which is quoted in the District Engineer's report, contains provisions for additional flood control storage, provided the licensee, Puget Sound Power and Light Company, is compensated for power losses. About 43 miles of mainstem levees have been constructed by local interests, but only a relatively low degree of flood protection is provided.

4. Problems and needs. --Flooding in the Skagit River Basin has caused heavy damages. The major floods of record have occurred from November through February, and were caused by heavy rain with accompanying snowmelt. The most recent major flood in February 1951, would have caused damages of almost $19 million if it had occurred in 1973. Future flood damages are expected to average about $4,246,000 annually.

5. Improvements desired. --Local interests have expressed a desire for flood control to include additional flood control storage in the Upper Baker Project. Their specific desires are further expressed by Skagit County's comprehensive flood control plan which includes additional storage at the Upper Baker Project, and the two Federally authorized projects, Avon Bypass Channel, and a levee and channel improvement.

6. Plan of improvement. --The District Engineer finds that additional flood control storage at the Upper Baker Project is feasible. The plan of improvement is modification of the operating schedule at the Upper Baker Project to provide 58,000 acre-feet of additional flood control storage on a seasonal basis. To provide the additional storage, the lake would be drawn-down from 1 November to 15 November and refilled beginning 1 March each year. Also as part of the plan, local interests are to continue their program of flood plain management.

7. Economic evaluation. --The District Engineer estimates first costs, which would be administrative costs necessary to initiate a change in project operation, at $21,000. The economic cost of providing replacement power from new alternative powerplants would be $434,000 annually. Average annual benefits, based on a 100-year period for economic analysis and a 5-7/8 percent interest rate, are estimated at $1,127,000. The benefit-cost ratio is 2.6. Use of a 6-1/8 percent interest rate would not change the benefit-cost ratio. Financial annual costs, necessary to compensate Puget Sound Power and Light Company for losses, would be $56,000 for replacement power from the Bonneville Power Administration,

in addition to $3,000 for interest and amortization of the initial administrative costs and impact monitoring studies for the first 5 years and $9,000 for Corps administrative costs. All costs would be a Federal responsibility.

8. Supplemental information. --Data were furnished to show the effect the proposed changes in operation of the Upper Baker Project would have on previously authorized projects. The supplemental information is tabulated below. Since an evaluation of the Avon Bypass Project indicated economic infeasibility as a first-added increment, it was not included in the other analyses shown.

	First Added	Second Added
Avon Bypass (Authorized)		
Annual benefits	$2,660,000	
Annual charges	3,850,000	
Benefit-cost ratio	0.70	
Levee and Channel Improvement (Authorized)		
Annual benefits	$1,035,000	$977,000
Annual charges	805,000	805,000
Benefit-cost ratio	1.3	1.2
Upper Baker (Proposed)		
Annual benefits	$1,127,000	$1,069,000
Annual charges	434,000	434,000
Benefit-cost ratio	2.6	2.5

9. Recommendations of the reporting officers. --The District Engineer recommends that the Upper Baker Project be operated to provide additional flood control storage space as described in his report. He further recommends that Puget Sound Power and Light Company be compensated by the Federal Government with power, in kind, for resulting hydroelectric power losses. The Division Engineer concurs.

10. Public notice. --The Division Engineer issued a public notice stating the recommendations of the reporting officers and affording interested parties an opportunity to present additional information to the Board. No communications were received.

Views and Recommendations of the Board of Engineers for Rivers and Harbors.

11. Views. -- The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. The improvements are justified and the requirements of local cooperation are generally appropriate.

12. The Board has carefully considered the report as to its compliance with the requirements of the Principles and Standards for Planning Water and Related Land Resources established by the Water Resources Council. It believes that the intent of the Principles and Standards has been fulfilled, and that the recommendations of the reporting officers have been developed through the application of prescribed planning procedures contained therein to meet the objectives of national economic development and environmental quality. The effects on regional development and social well-being were evaluated, and the Board believes that the proposed improvements would provide a significant contribution to the regional economy and improvement of social well-being. The Board has also carefully considered the environmental effects, including those discussed in the Revised Draft Environmental Impact Statement dated June 1975, and notes that the proposed improvements are expected to have little adverse effect.

13. Recommendations. -- Accordingly, the Board recommends authorization of changes in operation of the Upper Baker Project to provide additional flood control storage space and compensation of Puget Sound Power and Light Company with power, in kind, for resulting hydroelectric power losses, generally in accordance with the plan of the District Engineer, and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable. Costs to the United States are presently estimated at $21,000 initially for administrative costs, $5,000 annually for the first 5 years for environmental impact monitoring studies, $56,000 annually for replacement power, and $9,000 annually for administrative costs. These recommendations are made with the provision that, prior to operation for additional flood control, non-Federal interests will agree to:

a. Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood-carrying capacity or hinder maintenance and operation, and control development in the project area to prevent an undue increase in the flood damage potential;

b. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the

flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project; and

c. At least annually, inform affected interests regarding the limitation of the added protection afforded by the project.

FOR THE BOARD:

J. W. MORRIS
Major General, USA
Chairman

Syllabus

The purpose of the study discussed in this report was to investigate the feasibility and desirability of providing additional flood control storage at Upper Baker project, owned and operated by Puget Sound Power and Light Company (Puget Power), as an early action element of the comprehensive plan adopted by the Pacific Northwest River Basins Commission for the Puget Sound and Adjacent Waters study area. Additional flood control storage at the Upper Baker project would help reduce Skagit River flooding downstream of Concrete, Washington, benefiting nearly 100,000 acres of flood plain which contain portions of the towns of Sedro Woolley, Burlington, Mount Vernon, and La Conner, as well as other smaller communities and substantial agricultural lands.

Skagit River flood plain currently is provided limited protection by locally constructed dikes and, since 1953, through use of 120,000 acre-feet of storage space in Ross reservoir, a hydroelectric project owned and operated by Seattle City Light. Also, 16,000 acre-feet of flood control storage is now provided at Upper Baker project as compensation for natural valley storage lost by project construction. The minimum safe channel capacity in leveed areas below the town of Burlington amounts to approximately 84,000 cubic feet per second (c.f.s.), representing a flood having an average recurrence interval of 3 years. Studies have found that the additional flood control storage at Upper Baker project partially meets the needs of the Skagit River basin for additional flood control and is consistent with Skagit County's adopted comprehensive flood control plan. Other flood control improvements, including the Federally authorized Skagit River Levee and Channel Improvement and Avon Bypass projects, are also elements of the county's long-range plan. The levee and channel improvement project is strongly supported by Skagit County and is expected to be scheduled for preconstruction planning subsequent to Congressional authorization of the power loss compensation called for in the plan recommended in this report.

Additional flood control storage space of 58,000 acre-feet at Upper Baker project was found to be justified. The recommended plan would be implemented by providing replacement power to Puget Power for power losses incurred as a result of the flood control operation. The power revenues foregone by the Federal Government in providing replacement power could amount to $56,000 annually. The average annual cost of the power loss used in economic analysis was based on providing equivalent power from new facilities, constructed through joint public-private financing. Average annual economic costs are estimated at $434,000. The average annual flood damage reduction benefits that would result from the proposed operation change are estimated at $1,127,000. The plan is economically justified with a benefit-cost ratio of 2.6 to 1.

There are no significant adverse environmental effects anticipated from implementing the proposed plan. Possibly, some reduction of sockeye salmon egg losses now occurring under the existing project operation may result incidental to the flood control drawdown. The revised project operation would be carefully monitored during the initial years of operation change to verify current expectations. The proposal is compatible with National Wild and Scenic River System status for the Skagit River as currently proposed by the U.S. Forest Service.

The District Engineer recommends that, subject to certain conditions of non-Federal cooperation as outlined in this report, the proposed operational change of the Upper Baker project in the interest of additional flood control storage be implemented and that Federal compensation of Puget Power for attendant power losses by power in kind and time from the Federal system (Bonneville Power Administration) be authorized. The annual revenues foregone by Bonneville Power in providing the replacement power would be considered a nonreimbursable Federal flood control cost, to be deducted each year from the reimbursable (power) operation and maintenance account of the Chief Joseph Dam, Rufus Woods Lake, Washington, project.

PUGET SOUND AND ADJACENT WATERS, WASHINGTON

AUTHORIZATION REPORT FOR ADDITIONAL FLOOD CONTROL

AT UPPER BAKER PROJECT,

SKAGIT RIVER BASIN, WASHINGTON

The Study and Report

Purpose and Authority

This report is an action document reflecting detailed flood damage reduction studies undertaken in followup to the Comprehensive Water and Related Land Resource Study of Puget Sound and Adjacent Waters, Washington. Information contained herein will provide a basis for congressional action leading to improved Skagit River flood control. The comprehensive and detailed project feasibility studies were authorized by the Flood Control Act of 1962, Section 209, Public Law 87-874. The comprehensive study, initiated in 1964 and completed in 1971, identified early action needs of the Puget Sound area for water and related land resource preservation, conservation, and development. Additional flood control storage at the existing Upper Baker project, constructed by Puget Sound Power and Light Company (Puget Power) in the interest of hydroelectic power generation, is an early action element of the comprehensive plan. The comprehensive plan was submitted to Congress by the U.S. Water Resources Council through the President's Office of Management and Budget in July 1974.

Scope of the Study

Detailed engineering, economic, and environmental impact studies were undertaken to determine the feasibility and desirability of providing additional flood control storage at Upper Baker project, shown on plate 1. Plate 2 presents features of the project.

Several alternative basin plans were previously investigated during the comprehensive studies, which addressed the Skagit River basin's recurring flood problems, as well as other water resource-related needs and problems. The studies reflected in this report were limited to examination of various volumes of additional flood control storage space at Upper Baker project and the alternative of not providing further flood control but merely relying upon existing State law and local ordinances to minimize the growth in flood damage potential. Expressions by concerned State and Federal agencies and local interests were considered. Studies were carried out only to the extent required to verify the feasibility of the proposal in terms of benefits and costs and institutional arrangements necessary for its implementation.

Study Participants and Coordination

U.S. Fish and Wildlife Service and Bonneville Power Administration of the Department of Interior, Soil Conservation Service and U.S. Forest Service of the Department of Agriculture, National Marine Fisheries Service of the Department of Commerce, Federal Power Commission, Environmental Protection Agency, agencies of the State of Washington, Skagit County, communities and towns lying within the Skagit River flood plain, and Puget Power participated in the studies reflected in this report. Public involvement and comments from various interest groups were solicited in the course of the study through public meetings and distribution of draft brochures. Such groups included the Sierra Club, Washington Environmental Council, Audubon Society, Leagues of Women Voters, Skagit Valley Grange No. 620, Skagit Conservation District, Skagit Environmental Council, and the Izaak Walton League of America.

The initial public meeting was held on 25 April 1973 following distribution of two drafts of the public brochure, which explained the study background and alternatives being considered. The public meeting was held to further afford local interests the opportunity to express their views and comment on the alternative proposed for study. Following the 25 April public meeting, a third draft brochure was distributed for comments. Subsequently, a number of informal meetings were held with local interests, Puget Power, and Skagit County officials. The final public meeting was held on 8 April 1975 in Mount Vernon, Washington to present the results of these studies, including the recommended plan. Prior to the meeting, a forth draft brochure was distributed to all known interested parties, containing the District's tentatively recommended plan. The final edition of the brochure is contained in appendix 3.

89-260 O - 77 - 3

The Report

Results of feasibility studies are presented in two parts: The main report and three appendices.

The main report is a nontechnical presentation of study results. A broad view of the overall investigation is provided along with the District Engineer's conclusions and recommendations.

Appendix 1 is a technical document organized in essentially the same sequence as the main report but providing detailed technical information required to support the conclusions and recommendations of this study. Appendix 2 contains all the correspondence pertinent to this study which adds to the understanding of the basic report and technical documents. Appendix 3 contains the final edition of the public brochure used to communicate information on the study and alternatives considered, as well as providing a forum for public and agency comment and debate on the alternatives.

Prior Studies and Reports

As previously discussed, the Puget Sound and Adjacent Waters Comprehensive Water and Related Land Resources Study, results of which are contained in a summary report and 15 supporting appendices, provided the basis for the study reflected in this report. The comprehensive study, undertaken by a Federal-State interagency task force of the Pacific Northwest River Basins Commission, considered all water resource problems and needs, including flood damage reduction. The Skagit River basin was analyzed as one of 11 major river basins or island groupings comprising the Puget Sound study area.

Further flood control storage at the Upper Baker project was identified in the Puget Sound comprehensive plan as an early action element. Also contained within the flood control portion of the comprehensive plan were the Avon Bypass and Skagit River Levee and Channel Improvement projects, previously authorized by Congress in the Flood Control Acts of 1936 and 1966, respectively. The sites of the authorized projects are also shown in plate 1.

Prior reports completed by the Corps of Engineers involving flood control improvements in the Skagit River basin are tabulated below:

Report	Date	Improvements Considered	Recommendations
H. D. 125 69th Congress 1st Session	1925	Basin flood control	Survey of flood control
H. D. 187 73d Congress 2d Session	1933	Basin flood control including Avon Bypass	Flood control improvements could not be recommended at that time
Preliminary Examination (not published)	29 March 1937	Basin flood control	Additional surveys for flood control were recommended
Survey Report (not published)	21 Feb 1952	Flood protection in delta area	Flood control improvements could not be recommended at that time
H. D. 483	30 Aug 1966	Basin flood control	Levee and channel improvement project along Skagit River, below Sedro Woolley and modification of authorized Avon Bypass to permit Federal participation in recreation facilities

Related Studies

Under authority of the Wild and Senic River Act (Public Law 90-542) the U.S. Forest Service is studying the Skagit River and several of its tributaries to determine their potential as additions to the national system. The Skagit River from the town of Mount Vernon to and including the mouth of Bacon Creek; the Cascade River between its mouth and the junction of its North and South Forks; the South Fork to the boundary of Glacier Peak Wilderness Area; the Suiattle River from its mouth to the Glacier Peak Wilderness Area boundary at Milk Creek, the Sauk River from its mouth to its junction with Elliott Creek, the North Fork of the Sauk River from its junction with the South Fork of the Sauk to the Glacier Peak Wilderness Area boundary were specified in the act for study. The Forest Service (USFS) has completed a draft report recommending recreational river classification of the Skagit River and has found additional flood control at Upper Baker project to be compatible with this classification (see Appendix 2, USFS letter dated 11 April 1975).

Resources and Economy of the Study Area

The Skagit River basin, lying in the northwest corner of the State of Washington, comprises an area of 3,140 square miles. The basin extends about 130 miles in a north-south direction and approximately 80 miles from east to west, between the crest of the Cascade Mountains and Puget Sound. The most northern end of the basin extends 28 miles into British Columbia, Canada, where it borders the Frazier River basin. The Nooksack basin lies immediately to the north and the Stillaguamish and Snohomish River basins to the south, with these basins and the Skagit draining into Puget Sound (see plate 1).

The entire floor of the Skagit River valley and deltas of the Samish and Skagit Rivers comprise the flood plain. The flood plain below the mouth of the Baker River covers nearly 100,000 acres, most of which are fertile delta land located downstream and west of the town of Sedro Woolley. Upstream of the town, the flood plain is mostly river bottom land. The extent of the flood plain is indicated by the brown shaded area on plate 1. Principal tributaries of the Skagit River include the Sauk, Cascade, and Baker Rivers. The drainage areas of the Skagit and its principal tributaries are shown in the tabulation below:

River	Skagit River Mileage	Drainage Areas Square Miles
Cascade River	78	185
Sauk River	65	732
Whitechuck River (Sauk River mile 26)		86
Suiattle River (Sauk River mile 13)		346
Baker River	56	298
Baker River at Upper Baker Dam (Baker River mile 9.3)		210
Skagit River at Ross Dam	104	999
Skagit River near Concrete	54	2737
Skagit River near Sedro Woolley	24	3015
Skagit River at Mount Vernon	13	3102

Interstate Highway 5 and State Highways 20, 538, and 9 cross the basin. Railroad transportation is provided by the

Burlington Northern Railroad and Northern Pacific Railway. There are five small airfields within the basin, but no commercial air service is available. Waterborne commerce contributes to the local economy with 2.5 million tons of foreign and domestic cargo handled in 1973 by the basin's terminals, located principally at Anacortes and La Conner. Downriver log raft movements on the Skagit, though significant in the past, were discontinued about 1964.

Environmental Setting

The Skagit River begins in the Cascade Mountains, and its setting changes in nature as the river decends in a westerly direction to the valley floor before entering Puget Sound some 135 miles from its origin. Starting out as a clear, cold, fast-flowing mountain stream, the river rapidly grows in volume when joined by its many tributaries before flattening in gradient and passing through the vast Skagit Valley into a saltwater estuary. The eastern portion of the Skagit basin is rugged, mountainous territory, famous for its wilderness value. There are over 270 permanent glaciers in this part of the basin. The terrain maintains its mountainous character between Marblemount and Sedro Woolley, but it is cut by broad, deep valleys through which the major river flows. Below Sedro Woolley the land levels out to a wide flood plain leading to the fertile Skagit Flats. (See photographs.)

Approximately 120 miles of the Skagit River are considered usable for boating. Literally hundreds of miles of unnavigable streams and creeks with intermittent flows meander through the basin, which is heavily timbered with conifers, including Douglas fir, cedar, and hemlock in the mountainous areas. Deciduous trees of alder, willow, and maple are found along the riverbeds and meandering channels. Few trees are found in the flood plain, which has been extensively cultivated for crop production.

Due to the proximity of the Pacific Ocean, temperature and precipitation are greatly influenced by the maritime air masses, which result in a mild but wet climate. During the winter, the basin is subject to numerous rainstorms which are often quite severe and follow in quite rapid succession. The mean annual temperature for stations in or near the basin varies from about 40° F at Mt. Baker lodge to about 52° F at Concrete. Temperature extremes have been recorded of 109° F at Newhalem and -14° F at the Darrington ranger station. During the summer months the weather is warm and relatively dry. Though approximately 75 percent of the precipitation in the Skagit basin

View of delta area looking west from Sedro Woolley and along the Skagit River toward the Straits of Juan de Fuca.

View of upper basin agricultural lands looking northeasterly. Sedro Woolley in the foreground is bordered on the right by the Skagit River. In the background is Mount Baker and the Cascade Range.

View of delta area looking westerly. Mount Vernon and the Skagit River are in the foreground with Padilla Bay and Anacortes shown in the background.

View of delta area looking northeasterly. LaConner and Swinomish Channel in the foreground are separated from Mount Vernon in the right background by the Skagit River.

falls during the period October through March, heavy winter snows occur in higher elevations and remain until late spring or early summer. The mean annual snowfall is 525 inches at Mt. Baker lodge and 5.6 inches at Anacortes. Precipitation over the basin varies greatly, with an annual range of 150 inches. The normal annual precipitation at Baker Lake is 103 inches, with area near the mouth of the Skagit River receiving 40 inches or less.

Significant archeological and historical resources are located mainly in the flood plain and along the saltwater shoreline. Principal items of interest include Indian habitation and pioneer developments. La Conner, a small, colorful community located on the edge of the Swinomish Channel, which connects Padilla and Skagit Bays, has been listed in the National Register of Historically Significant Towns.

Geologic Setting

The mountainous region of the upper Skagit basin consists of ancient metamorphic rocks, largely phyllites, slates, shales, schists, and gneisses together with intrusive granite rocks and later andesite lavas, and pyrodastic deposits associated with Mount Baker and Glacier Peak. The valleys are generally steep sided and frequently flat floored. Valley walls are generally mantled with a mixture of rocky colluvium and to considerable elevation by deposits of continental and alpine glaciation. These deposits are a heterogeneous mixture of sand and gravel together with variable quantities of silt and clay depending on mode of deposition. The valley floor of the Skagit River flood plain below Concrete is composed of sands and gravels diminishing to sands, silts and some clays downstream. Below Hamilton, fine flood plain sediments predominate.

The valley of Baker River in the vicinity of Baker Lake reservoir is geologically significantly different from most of the other Skagit tributaries. This is largely due to the influence of Mount Baker, a volcanic cone rising to elevation 10,778 feet above mean sea level, immediately northwest of the valley. The last dated major eruption, about 10,000 to 12,000 years ago, passed a lava flow down Sulphur Creek blocking the valley. Subsequent cutting of a narrow canyon through this lava flow provided the site for Upper Baker Dam. Subsequent volcanic activity as recent as 200 years ago has resulted in flows of hot ash, debris and mud down tributary valleys into the Baker Valley. The result is a variable mantle of volcanic pyroclastic and debris flow materials overlying glacial deposits on the west side of the valley.

Evidence of recent volcanic activity is indicated by the increase in geothermal activity at Mount Baker's summit crater early in 1975. The east side of Baker Lake reservoir largely consists of a mantle of glacial deposits and colluvium over slates and shales. Some of the glacial deposits are silts and sands deposited in a glacial lake environment.

Natural Resources

The basin is rich in natural resources. The river and its tributaries are used for recreation, fish and wildlife production, hydroelectric power generation, irrigation, and municipal and industrial water supply. Considerable logging takes place at the higher elevations, which is important to the basin's economy. Deer, elk, bear, and other big game and smaller animals are found throughout the basin. Waterfowl including snow geese, black brent, whistling swan, mallard, and many other species of duck are found in lowland areas and adjacent estuaries. The Skagit River is an important producer of salmon with chinook, silver, sockeye, chum, and pink runs spawning in its waters. Other anadromous fish include steelhead and cutthroat trout.

The Baker River drainage, which includes Lake Shannon and Baker Lake (reservoirs created by Puget Power hydroelectric projects), supports a wide range of fish and wildlife species. Resident rainbow, cutthroat, and brook trout are found in the basin's waters, as well as whitefish, kokanee, and Dolly Varden. Anadromous species which are transported past Puget Power's hydroelectric dams, located 1 and 9 miles above the mouth of the Baker River, include chinook, coho, sockeye, pink, and chum salmon and steelhead and cutthroat trout. Rainbow trout, planted annually in Baker Lake by Puget Power, support a put-and-take fishery. Puget Power, in cooperation with the Washington Department of Fisheries, maintains an anadromous fish collection facility at Concrete, just below Lower Baker project. The waters of the Baker drainage are extremely clean and provide an excellent habitat for natural reproduction. The rearing capability provided by Baker Lake and spawning habitat of its tributaries, combined with the artificial spawning areas constructed by Puget Power as mitigation for project-caused losses, enables the Baker River to contribute significantly to the sport and commercial fisheries of the Pacific Ocean, Puget Sound, and Skagit River.

All of the wildlife species found in other portions of the Skagit basin are also resident to the Baker drainage.

There are no known archeological or historical sites on lands surrounding the Upper Baker project area. Archeological field studies were found to be unnecessary, as no change in maximum lake elevation was contemplated during the course of the studies.

Skagit basin is a popular tourist and recreation area, sharing portions of the North Cascades National Park and Glacier Peak Wilderness with other basins. Approximately 222,000 visitors entered the Baker River drainage during 1972 to make use of facilities provided at two U.S. Forest Service campgrounds, a campground constructed by Puget Power, and a private resort. Recently, Puget Power has expanded its trout stocking program by constructing and operating a trout hatchery near the lake for this purpose.

For the most part, the potentials of the Skagit basin for tourism and recreation have not been developed. In 1972 State Highway 20, often refered to as the "North Cascades Highway," was opened, allowing public crossing into eastern Washington from the Skagit basin. Given the rural character of this region and its impressive natural endowment, the opportunities for future development are considerable.

Human Resources

The 1970 census placed the population of Skagit County, which contains nearly all of the population of the Skagit basin, at 52,380. The major centers of population include Anacortes, Mount Vernon, Sedro Woolley, Burlington, Concrete, and La Conner. The overall increase in population since 1960 has occurred through urbanization in and around the communities of Mount Vernon and Burlington, and to some extent Sedro Woolley. Although the county is becoming increasingly urban, it is doing so at a declining rate. The county's overall population growth was only about 2 percent for the decade ending in 1970.

While specific population and employment data have not been assembled for the Skagit basin itself, data for Skagit County used in this report reflect pretty well the basin situation. The following tabulation shows the historical population of Skagit County in comparison to the State of Washington and also provides census figures for the larger communities.

HISTORICAL POPULATION
WASHINGTON AND SKAGIT COUNTY

	1940	1950	1960	1970	Average Annual Percent Increase (1940 to 1970)
Washington	1,736,200	2,379,000	2,853,200	3,409,300	2.3
Skagit County	37,650	43,270	51,350	52,380	1.1
Anacortes	5,880	6,920	8,410	7,700	0.9
Burlington	1,630	2,350	2,970	3,140	2.2
Concrete	860	760	840	570	(-1.4)
La Conner	620	590	640	640	0
Mount Vernon	4,280	5,230	7,920	8,800	2.4
Sedro Woolley	2,950	3,300	3,700	4,600	1.5

HISTORICAL EMPLOYMENT,
PERSONAL INCOME AND PER CAPITA INCOME,
SKAGIT COUNTY

	1950	1960	1970
Employment	NA	18,500	19,700
Personal income (millions of current $)	56.3	NA	188
Per capita income (current $)	1,297	NA	3,585

NA - Not available

Total employment in the county in 1971 averaged 20,550, up from employment of 19,700 in 1970 shown in the tabulation above. Basic economic activities include agriculture and processing of agricultural products; forestry and lumber production; and to a much minor extent fishing, mining, and petroleum refining. Recreational and tourist industry also has a significant impact on the basin's economy. The slow growth in county employment opportunities has, however, resulted in a net out-mitigation of population. Despite this, the unemployment rates in the county have been high throughout the decade, with the lowest unemployment rate of 7.4 percent having occurred in 1968. Skagit County contains a very small minority population, less than 2 percent of the total. The average age of the population increased over the past decade, reflecting a recent decrease in the ratio of younger county residents to older persons.

The seasonal nature of the county's basic industries contributes to the high unemployment rates, but generally depressed market conditions are felt to be the biggest contributing factor. Within manufacturing, employment in food processing and stone-clay-glass has declined sharply. However, employment in lumber and wood products has maintained its levels. Trade, government, and general services have increased, although the total employment has only risen by 6 percent during the past decade in contrast to a State increase of 26 percent over the same period.

Development and Economy

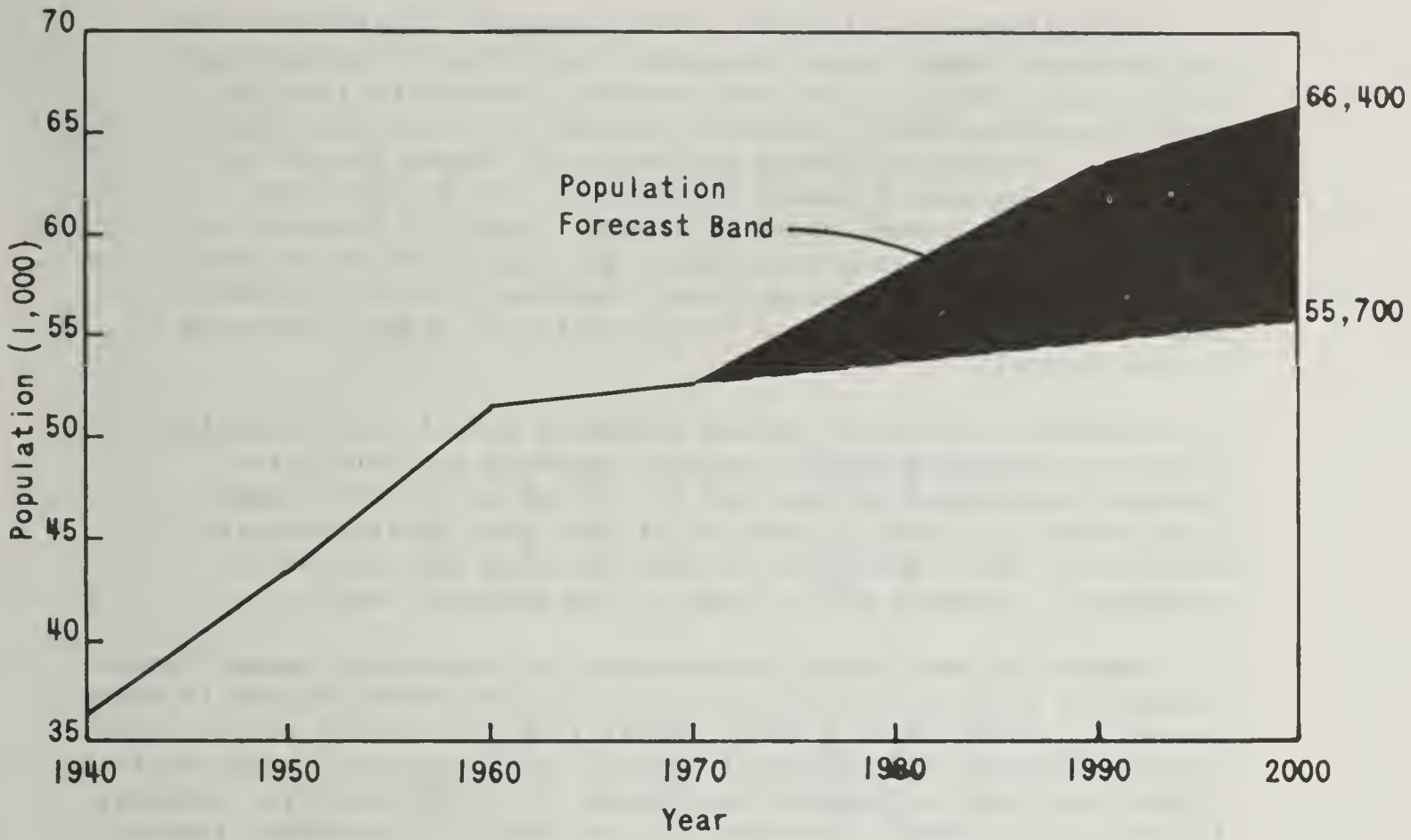
About 92 percent of the total land in the Skagit-Samish River basins is utilized for forest production, with agriculture and urban-intensive uses amounting to 5 and 1 percent, respectively.

Present land use for the Skagit-Samish basins is shown in the following tabulation:

Land Use Category	Present Use (acres)	Percent
Forest 1/	1,753,400	91.7
Range	19,800	1
Cropland	100,500	5.3
Rural nonfarm	20,100	1
Intensive	18,800	1
Total	1,912,600	100

1/Includes alpine and other nonforested lands normally associated with forests.

SOURCE: Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters, State of Washington, Appendix XV, Plan Formulation, March 1970.



PROJECTED POPULATION, SKAGIT COUNTY

SOURCE: Skagit Regional Planning Council, Comprehensive Land Use Planning Alternatives For the Skagit River Floodplain and Related Lands, April 1973.

Skagit Regional Planning Council prepared alternative population projections of Skagit County indicating a range of 55,700 to 66,400 persons by the year 2000, compared to 52,380 in 1970, as shown in the illustration. This represents an average annual compound growth rate of 0.2 to 1.0 percent per year. The average annual historical growth experienced over the past 30 years was 1.1 percent. Because upland areas are not easily developed, much of the basin's population resides within the Skagit River flood plain and a certain amount of future growth is expected to occur in the flood hazard area. However, Federal policies and State and local regulations should minimize those new developments which would be subject to serious flood hazards.

The following tabulations present economic projections for the 12-county Puget Sound area under two different assumptions of fertility rates. These projections, prepared by the U.S. Water Resources Council, provide a basis for comparison with the future population levels projected for Skagit County by the Skagit Regional Planning Council. As can be seen, the range of future growth rates for Skagit County is expected to be exceeded by the growth projected for the entire Puget Sound area under Series "C" assumptions. However, the rate forecast under Series "E" assumptions falls within the range predicated by the council.

Although agriculture should remain as one of the controlling factors influencing Skagit County's economic activity, its relative importance is expected to decline as economic expansion gradually forces a transfer of land from agriculture to urban use. Also, expansion of manufacturing and tourism is expected to increase their share of the economic base.

Lumber and wood products manufacturing employment should remain relatively stable in the future as the forest resource base is being managed on essentially a sustained-yield basis. While output could expand somewhat, technological changes are expected to continue to offset the need for expanded employment in this industry. However, if more of the timber harvested in the county is processed locally, this could produce some growth in employment.

Excellent transportation routes, which tie the county with the major metropolitan centers of Seattle, Tacoma, and Everett, have led some industries to consider the possibility of expanding into Skagit County. While several metallic and nonmetallic mineral deposits are known to lie in the county, their future development is uncertain due to the lack of data regarding quality and quantity. The recently completed North Cascades Highway may foster future exploration of the county's mineral resources.

Tourism and recreation should continue to rank among the most important future-growth industries in Skagit County. Economic impact will result from people entering the county to visit North Cascades National Park; persons passing through the county traveling to and from San Juan Islands and Canada; and further development of resorts, retirement homes, and vacation homes.

Problems and Needs

The water resource problems and needs discussed in this report are limited to Skagit River flooding that occurs below the mouth of the Baker River. This is the portion of the

OBERS Series "C"
Puget Sound Area

	1969	1990	2000	2020	Average Annual Percent Growth 1969-2020
Population	2,197,000	3,139,000	3,601,000	4,704,000	1.5%
Employment	866,661	1,219,500	1,440,700	1,906,700	1.6
Per capita income	$3,810	$6,690	$8,912	$15,097	2.8
Total personal income 1/	$8,369,000	$21,001,000	$32,095,000	$71,017,000	4.4
Earnings 1/					
Agriculture (forestry & fisheries)	$69,888	$93,800	$111,900	$190,500	2.0
Wholesale & retail trade	$1,170,000	$2,897,000	$4,399,000	$9,625,000	4.2
Trade & services	$2,054,000	$5,553,000	$8,689,000	$19,822	4.7

1/$1,000 1967 dollars.

OBERS Series "E" 1/
Puget Sound Area

	1970	1990	2000	2020	Average Annual Percent Growth 1970-2020
Population	2,246,000	2,322,000	2,710,000	3,012,000	.6%
Employment	885,295	1,112,100	1,237,400	1,353,000	.8
Per capita income	$3,689	$6,599	$8,686	$13,954	2.7
Total personal income 2/	$8,287,000	$16,777,000	$23,538,000	$42,037,000	3.3
Earnings 2/					30 Year
Agriculture (forestry & fisheries)	$56,008	$61,700	$67,600	NA	.6
Wholesale & retail trade	$1,131,926	$2,106,500	$2,845,000	NA	3.1
Trade & services	$2,009,730	$4,545,500	$6,545,200	NA	4.0

1/Series E represents a fertility rate of 2,100 births per 1,000 women to be achieved by 2000 as compared to 2,777 for Series C. This substantially reduces the population projection.

2/1,000's of 1967 dollars.

Skagit River flood plain which would be affected by additional flood control storage at the Upper Baker project. The flood plain below the mouth of the Baker River comprises almost 100,000 acres of land, including fertile and highly productive agricultural areas, the community of Burlington, and portions of Sedro Woolley and Mount Vernon, as well as La Conner.

Status of Existing Plans and Improvements

Farmland and towns in the delta flood plain west of Sedro Woolley are afforded low-level protection by locally constructed levees which prevent flooding from the river and in the lower estuary from tidal saltwater. About 43 miles of main stem river levees have been constructed to give some protection against spring and winter floods. Levees along the saltwater bays and channels prevent inundation by tidal flows. There are 16 diking districts which have inclosed a total of 45,000 acres of land within the levees, with individual owners having inclosed an additional 1,000 acres. Between Concrete and Sedro Woolley, low levees protect several rural areas and the town of Hamilton from minor floods.

The existing levees below Burlington vary in level of protection and will safely withstand riverflows from 84,000 cubic feet per second (c.f.s.) to 130,000 c.f.s. Floods of these magnitudes can be expected to recur on the average of once every 3 to about once every 10 years, respectively. Safe capacity flows are based on a minimum 2-foot levee freeboard allowance. New levees are required to have 3 feet of freeboard above the design flow for safety and to allow for settlement. However, as the existing levees have been in place many years, a settlement allowance of 1 foot is not needed. The existing levees were generally constructed from river sediments ranging from fine silty sand to fine sandy silt, which tend to be unstable when saturated.

Seattle City Light has constructed three hydroelectric power dams on the main Skagit River. Ross Dam (at river mile 105) has a reservoir with usable storage capacity of 1,280,000 acre-feet. Since 1953, 120,000 acre-feet of Ross Reservoir space has been reserved for flood control from 1 December to 15 March. The other two projects, Diablo and Gorge Dams, are located at river miles 100 and 96, respectively. Only Ross Dam provides reserved flood control storage space, while Diablo and Gorge are run-of-the-river projects. Puget Power operates two hydroelectric power projects on the Baker River - Lower and Upper

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Baker dams and reservoirs. Sixteen thousand (16,000) acre-feet of storage space at the Upper Baker project is available for flood control regulation to compensate for valley storage lost as a result of the project. Photographs of Ross and Upper Baker projects are shown on the following page.

No Federal flood control works have been constructed in the Skagit River basin. The Flood Control Act of 1936 authorized the Avon Bypass Channel, a project for the partial control of floods in the lower Skagit Valley. The bypass channel, as proposed, would divert excess Skagit River flow from the main river channel near Burlington to Padilla Bay. The project has not been undertaken, as Skagit County has been unable to meet the requirements of local participation. Substantial costs would be involved in the relocation of transportation facilities and the acquisition of right-of-way. Also, the project would pass through an area used for agricultural purposes, resulting in significant disruptions. The most recent studies, conducted in 1966, indicate the Avon Bypass Channel should have a capacity of 60,000 c.f.s., although it would be possible to construct the facility to handle larger flows.

The Flood Control Act of 1966 authorized construction of the levee and channel improvement project along the Skagit River from just upstream of Mount Vernon downstream along both its north and south forks. Also authorized by the 1966 act was Federal involvement in the inclusion of recreation facilities as part of the Avon Bypass project. The levee and channel improvement project would provide a uniform minimum safe channel capacity of 120,000 c.f.s. from just upstream of Burlington downstream through the delta. This capacity would allow safe passage of floods having an average recurrence interval of up to 8 years. In combination with the Avon Bypass, the levee and channel improvement project would provide protection against floods having an average recurrence interval of up to 35 years. The latter project has been held up pending additional storage development or construction of the Avon Bypass.

The Flood Disaster Protection Act of 1973 requires that counties and other municipalities, in order to qualify for the Federal flood insurance program, must adopt effective zoning and building code regulations. Skagit County has qualified for the flood insurance program and has demonstrated an outstanding initiative in pursuing these measures.

A flood information report, "Flood Information Study, Skagit River Basin, Washington, April 1967," prepared by the Seattle District, provided basic data for use by the county in seeking

View of Upper Baker Dam

View of Ross Dam

to minimize the development in the flood plain of those types of facilities that would result in significant risks to people and property damage. Studies conducted in 1974 by the Seattle District Engineer for the Department of Housing and Urban Development, Flood Insurance Administration, provided additional information and an update of previous data which will be used in establishing actual rates for flood insurance purchased in Skagit County.

Flood Problems

The Skagit River has flooded many times in the past. However, the most recent flood causing extensive damage occurred in February 1951. Heavy damages occurred to crops, lands, buildings, roads, railroads, and other improvements. Historical Skagit River floods which have occurred since 1896 are as follows:

HISTORICAL SKAGIT RIVER FLOODS

Date	Discharge 1/ (c.f.s.)	Damages 2/ (1973 Prices and Conditions of Development)
November 16, 1896	185,000	$22,550,000
November 19, 1897	190,000	22,850,000
November 16, 1906	180,000	20,350,000
November 30, 1909	220,000	29,500,000
December 30, 1917	195,000	23,850,000
December 13, 1921	210,000	27,050,000
February 11, 1951	150,000	18,630,000

1/Observed discharges near Sedro Woolley, Washington

2/Estimated damages based on 1973 regulated discharge conditions.

Damages shown are estimates, based on 1973 prices and conditions. In effect they provide a measure of what would have been experienced had the respective floods occurred in 1973. All of the major floods of record, which took place during the period November through February, were caused by high rates of precipitation with accompanying snowmelt. This type of flood has a crest that is normally higher and of shorter duration than the annual spring snowmelt high water.

A winter flood peak is of short duration; and as a result, the discharge in the delta area can be much reduced by valley storage, as occurred in 1949 when the peak discharge near Concrete was 154,000 c.f.s. and only 114,000 c.f.s. at Mount Vernon. Nookachamps Creek area on the left bank between Mount Vernon and Sedro Woolley is a major source of natural valley storage. Storage in the area can reduce major peaks from 15,000 to 25,000 c.f.s. downstream from Sedro Woolley. However, if the near peak flow continues for an extended period, the discharge can be greater at Mount Vernon than at the upstream points because of the downstream inflows and the reduced effectiveness of valley storage.

The February 1951 flood was a result of weather conditions typical of western Washington for that time of year. Moderate to heavy rains were followed by light rain resulting in a saturated soil condition. This in turn was followed by a record low pressure system accompanied by a flow of warm, moist air which produced excessive precipitation. The freezing level during this period was about 10,000 feet. The heaviest precipitation occurred on 9 February with a 24-hour amount of 6.39 inches at Silverton, 6.21 inches at Diablo Dam, and 1.83 inches at Sedro Woolley. The flood produced as a result of this precipitation had a peak discharge of 139,000 c.f.s. at Concrete, a recorded peak of 150,000 c.f.s. at Sedro Woolley, and a peak of 144,000 c.f.s. at Mount Vernon. Upstream storage reduced the peak discharge at the gage near Concrete by about 13,000 c.f.s. However, as the peak had quite a long duration and a large amount of inflow occurred between Concrete and Mount Vernon, channel storage had little effect on reducing the peak stage in the lower reaches. The flood remained near its peak for 6 hours at Mount Vernon. The duration of this peak was significant to the severity of the flood as it minimized the effectiveness of natural storage relief provided by the Nookachamps Creek area. Dikes failed because they lacked sufficient cross-sectional dimensions to withstand long periods of high water. The existing dikes are somewhat improved over the 1951 condition. Shown on the next page are photos taken of the Skagit River flood plain during the 1951 flood.

Future floods, based on 1974 prices and conditions of development in the Skagit Valley, are expected to result in damages which would average about $4,246,000 annually.

February 1951 view of flooded area between Burlington Bend and Burlington, looking upstream.

View of flooded area upstream of Burlington Railroad Bridge at Mount Vernon, Washington, during February 1951 flood.

February 1951 view of flooded delta area looking upstream, showing Diking District #13 in foreground.

View of flooding and levee failure at Conway, Washington, during February 1951 flood.

AVERAGE ANNUAL FLOOD DAMAGES
(1974 Prices and Conditions)

Category	Damages
Agricultural	$1,843,000
Commercial	1,157,000
Residential	1,027,000
Other - rural	91,000
Other - urban	86,000
Emergency aid	42,000
Total	$4,246,000

Other Needs

Other water and related land resource needs and problems do exist in the Skagit River basin. These have been previously identified in the Puget Sound and Adjacent Waters Comprehensive Study and are discussed in a summary report and 15 supporting appendices. 1/ The recommended operation change at the Upper Baker project is specifically a single-purpose flood control proposal provided for by the Federal Power Commission (FPC) license which authorized the project. Studies leading to this report have been limited to an evaluation of the feasibility of providing additional flood control storage space at the project, within the provisions of the FPC license, and the determination of the effects and impacts on other resource uses, such as hydroelectric power generation and fish and wildlife production. Investigation of other basin water resource needs was beyond the scope of the authorized study.

Improvements Desired

Public meetings were held on 25 April 1973 in Burlington, Washington and on 8 April 1975 in Mount Vernon, Washington. Federal, State, county, and local and private interests were

1/Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters, State of Washington, Puget Sound Task Force - Pacific Northwest River Basins Commission, 1971.

in attendance at both public meetings. A number of informal meetings were held with Federal, State, and county, and local and private interests during the period between the two public meetings.

In 1970, Skagit County adopted a comprehensive flood control plan when they formed a countywide flood control district in accordance with the laws of the State of Washington. The flood control district enables the county to assume the responsibility of sponsorship of various flood control improvement projects. Obtaining flood control storage from the existing Upper Baker project is currently viewed as phase one of the county's comprehensive flood control plan. Phase two of the plan provides for construction of the levee and channel improvement project authorized by the Flood Control Act of 1966. Phase three would be additional flood control storage on the Sauk River and/or construction of the Avon Bypass. The county has consistently, at the public meetings and in recent correspondence to the State of Washington's congressional delegation reaffirmed its desire for flood control improvements, particularly additional storage at the Upper Baker project. Skagit County has asked that the previously authorized Skagit River Levee and Channel Improvement project also be undertaken as soon as possible.

All those who expressed their views at the final public meeting, indicated agreement with the recommended plan. Skagit County Commissioners, in a letter dated 7 April 1975, read at the meeting (see appendix 2) stated they would meet the local requirements called for in this report. Because the plan does not involve the construction of new facilities but merely calls for changing the operation of an existing project, without significant environmental impacts, no opposition has been voiced by environmental groups or fish and wildlife agencies. However, some concern was expressed by the former over possible flood plain development resulting from the increased flood protection provided by the plan.

Formulating a Plan

Because the Skagit River basin has a potential for significant flood damages and serious disruption of its social-economic environment, flood control improvements are of utmost importance. While other water resource needs exist within the basin and have been identified through the Puget Sound and Adjacent Waters Comprehensive Study, this report deals only with flood damage reduction and specifically the objectives of (1) determining whether or not additional flood control storage should be provided

at this time at the Upper Baker project in order to comply with Skatig County's desire for improved flood protection; and (2) if so, how the project should be operated, to produce optimum flood damage reduction in the lower Skagit basin. Given these objectives, this study was limited to an examination of three conceptual alternatives. Alternative 1 involved doing nothing to resolve existing and future flood damage problems; alternative 2 would rely only on the existing flood control works including upstream storage plus flood plain management by Skagit County and the State of Washington; alternative 3 combined additional storage at the Upper Baker project with flood plain management. Under alternative 3 various volumes of storage and two possible operating schemes were considered.

The U.S. Fish and Wildlife Service and National Marine Fisheries Service have expressed a desire for having the flood control drawdown occur earlier than necessary for flood control purposes, in order to reduce the potential for sockeye spawning along the higher elevations of the lakeshore when the Upper Baker project spawning channels are filled to capacity. When sockeye spawn at the higher elevations and the reservoir is later drawn down for hydroelectric power generation, the eggs are exposed to the atmosphere. As the purpose of the earlier drawdown would be to increase sockeye production over existing levels, the drawdown would have to be justified by fishery enhancement benefits. Some future investigation by the appropriate state and Federal fish and wildlife agencies should be undertaken to evaluate the justification of the fishery enhancement proposal. Any further change in project operation would require approval by the Federal Power Commission. No provision currently exists in the license for operating the project for fishery enhancement purposes.

Basis of Formulation and Evaluation Criteria

The formulation and evaluation of alternatives was done in compliance with the U.S. Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources." Hydrologic and hydraulic data were obtained through Corps investigations, as well as information received from other Federal and State agencies. Socioeconomic data used in evaluating the benefits and costs of the various alternatives considered were also derived by the Corps and obtained from other sources. The Federal Power Commission provided data used in evaluating power losses. Federal and State agencies having expertise in the fields of fish and wildlife management were relied upon to assist the Corps in its evaluation of the environmental impacts that additional upstream storage at the Baker River project could have on natural resources.

Technical Criteria

The following important technical criteria were adopted for use in developing a recommended plan:

a. Minimum safe Skagit River channel capacity in the leveed areas downstream from Burlington is 84,000 c.f.s., based on a freeboard allowance of 2 feet.

b. Upper Baker project would be regulated for flood control when the Skagit River discharge near Concrete is forecast to reach 90,000 c.f.s. (84,000 c.f.s. discharge at Mount Vernon). The Skagit River near Concrete stream gage is downstream of the confluence with Baker River.

c. When operating Upper Baker project for flood control, the Baker River discharges into the Skagit River at Concrete would not be reduced below the 5,000 c.f.s. power generation capacity of the Upper Baker project.

d. Baker River discharges following flood regulation would be increased by releases from the Upper Baker project until full flood control storage space is regained with the project regulated during this time to avoid raising the Skagit River discharge above the peak experienced initially.

e. The Ross Dam project would continue to be operated for flood control during the period 1 December to 15 March of each year with 120,000 acre-feet of storage reserved for flood control in accordance with the project license issued by the Federal Power Commission.

Economic Criteria

General economic criteria utilized are summarized as follows:

a. Tangible benefits must exceed project economic costs.

b. Scope of the development is such to provide the maximum net benefits, however, intangible considerations, such as risk to lives and property, could result in a project size which is greater than that which would produce maximum net benefits.

c. There are no more economical means, evaluated on a comparable basis, for accomplishing the same purpose or purposes which could be precluded from development if the recommended plan were undertaken. This limitation refers only to those alternative possibilities that would be physically displaced or economically precluded from development if the recommended plan were implemented.

The economic benefits were initially evaluated based on 1973 prices and conditions of development within the Skagit River flood plain, projected over a 100-year period of economic analysis. Following agency review of the draft authorization report benefits were updated to 1974 prices and conditions. An interest rate of 5-7/8 percent was used to discount future benefits. The average annual costs were taken as the cost of obtaining replacement power from combined public-private financed projects at an interest rate of 10 percent for private and 7-1/4 percent for public (non-Federal) financing (Federal Power Commission power values based on July 1974 price levels). The costs were derived for alternative power production (energy and capacity) to meet power losses computed for four cases of flood control reservoir operation rule curves. Case I represented the existing condition of 16,000 acre-feet provided as replacement for lost valley storage. Cases II, III, and IV represented 66,000; 100,000; and 74,000 acre-feet of total storage, respectively. (See appendix 2, Puget Power letter dated 3 May 1974.) Power losses used to compute economic costs were taken as the differences between Case I and Cases II, III, and IV. The power loss costs used in the economic evaluation of the proposed project operation change are substantially greater than the actual cost of providing replacement power to Puget Power, which would be the power revenues foregone based on the power rate schedule in effect by Bonneville Power Administration during each year's operation. Annual costs also include the administration of additional flood control regulation at Upper Baker project with provision for monitoring environmental impacts that could occur during the drawdown period.

Environmental and Other Criteria

The following environmental criteria were employed in formulating the recommended plan:

a. Impacts of alternatives be carefully evaluated using an interdisciplinary approach utilizing fishery biologists, geographers, civil engineers, and other disciplines.

b. Fishery enhancement, except as incidental to flood damage reduction objectives, is beyond the scope of authorized studies.

c. All of the basic steps which are required in the preparation of an impact statement consistent with the National Environmental Policy Act of 1969 be followed.

d. Detrimental environmental effects are to be avoided where possible and feasible mitigating features considered when such effects cannot be avoided.

e. Public health, safety, and social well-being, including the possible loss of life, are to be carefully considered.

Solutions Considered

Three possible courses of action were evaluated in the process of arriving at a recommended plan that best satisfied the planning objectives with minimal adverse social and environmental impacts. The alternatives were: Do nothing, flood plain management alone, and flood plain management with additional flood control storage at Upper Baker project. A comparative summary of the significant beneficial and adverse effects of each alternative plan with respect to national economic development, environmental quality, regional development, and social well-being is given in table 1. More extensive data on the effects of each plan are contained in appendix 1 section D. The following paragraphs describe the alternatives and summarize their contributions to the planning objectives.

Alternative 1 - Do Nothing. This involves relying only on existing flood control facilities, including levees and upstream storage at Ross project for flood protection with no effort made to stem the growth of future flood damages through management practices.

As Skagit County and the State of Washington through the Department of Ecology have already established an effective flood plain management program implementation of alternative 1 would be a step backwards. Assuming this were done average

annual flood damages would be expected to grow from $4,246,000 in 1974 to $9,128,000 by the year 2027. Those costs would be borne by local residents in terms of flood damages, and by Federal and local governments in flood fighting and protection works repairs. This plan would result in a deterioration of the flood plain environment. Disruption of public services and potential hazard to life, health, and safety would continue unmitigated. Consequently the plan would not meet the planning objectives.

Alternative 2 - Flood Plain Management Alone. Under Alternative 2 reliance would remain on existing flood control facilities; but in addition, management measures including land use zoning, development restrictions, early flood warning, etc. would be employed to reduce the flood damage growth potential in the Skagit basin. Flood insurance, while made possible by proper local implementation of land use management practices in flood hazard areas, will not reduce damages but merely provide a means of compensation to the affected property owner. The availability, however, of Federally subsidized flood insurance acts as an inducement for flood plain management. Flood proofing of new buildings also is part of alternative 2. Existing buildings generally do not lend themselves to this measure because costs are usually prohibitive. In addition some buildings cannot be flood proofed effectively and public utilities and personal property, such as automobiles, gardens, yards, and furnishings, etc. would still be subject to flood damage. While this alternative would be effective in helping to stem the rate of growth of average annual flood damages it would do little to aid those persons already residing in the Skagit flood plain.

Flood damages with flood plain management would grow to $6,353,000 by the year 2027, or about 30 percent less than under alternative 1. The benefit-cost ratio of alternative 2, is very favorable at 3.1, thereby justifying continuation of the existing program. However, flood plain management of itself would not meet the planning objectives.

Alternative 3 - Flood Plain Management with Additional Flood Control Storage at Upper Baker Project. This proposal takes advantage of the capability of Puget Power's existing Upper Baker project to reduce Skagit River peak discharges during major flood events. The project operation would be changed through lowering of the reservoir during the winter flood season, providing flood storage space in addition to the 16,000 acre-feet now provided as replacement for natural valley storage lost when the project was constructed. Flood plain management, defined under alternative 2, also is part of this proposal.

TABLE 1

SUMMARY COMPARISON OF ALTERNATIVE PLANS

	Alternative 1 Do Nothing	Alternative 2 Flood Plain Management Alone	Alternative 3 Flood Plain Management with Additional Flood Control Storage at Upper Baker Project
PLAN DATA			
Structures	None	None	No new structure. Use made of 58,000 acre-feet of Puget Power's Upper Baker Project storage capacity.
Nonstructural Components	None	1. Existing State and County flood hazard zoning and requirements for flood proofing of all new structures in floodprone areas. 2. Federal flood insurance program which precludes Federally insured financing in the absence of local government qualification for insurance program.	1. Existing State and County flood hazard zoning and requirements for flood proofing of all new structures in floodprone areas. 2. Federal flood insurance program which precludes Federally insured financing in the absence of local government qualification for insurance program.
Land Requirements	None	None	None

TABLE 1

SUMMARY COMPARISON OF ALTERNATIVE PLANS (Cont'd)

	Alternative 1 Do Nothing	Alternative 2 Flood Plain Management Alone	Alternative 3 Flood Plain Management with Additional Flood Control Storage at Upper Baker Project	
			2nd Added[3]	Combined[4]
NATIONAL ECONOMIC DEVELOPMENT				
Implementation Cost				
Federal	0	[2]	$21,000	$21,000
Non-Federal	0		[2]	[2]
Total	0		$21,000	$21,000
Existing Conditions (1974 prices)				
Average annual flood damages	$4,246,000	$4,246,000	$4,246,000	$4,246,000
Average annual damages prevented	0	0	1,004,000	1,004,000
Average annual residual damages	4,246,000	4,246,000	3,242,000	3,242,000
Average annual benefits	.0	0	1,004,000	1,004,000
Average annual charges	0	0	434,000	434,000
Average annual net benefits	0	0	570,000	570,000
Benefit-cost ratio	NA	NA	2.31	2.31
With Future Benefits (Economic Analysis Period 1977-2077)				
Average annual flood damages	$5,554,000[1]	$5,554,000[1]	$4,766,000	$5,554,000
Average annual damages prevented	0	788,000	1,127,000	1,915,000
Average annual residual damages	5,554,000	4,766,000[5]	3,639,000	3,639,000
Average annual benefits	0	1,058,000[5]	1,127,000	2,185,000
Average annual charges	0	341,000	434,000	775,000
Average annual net benefits	0	717,000	693,000	1,410,000
Benefit-cost ratio	NA	3.10	2.60	2.82

1/Presume no restriction on future development within flood hazard areas.
2/Ongoing program.
3/Economic data reflects conditions with additional flood control storage at Upper Baker being second added to flood plain management.
4/Economic data reflect combined effects of additional Upper Baker project flood control and flood plain management.
5/Includes damages prevented ($788,000) and flood insurance payouts ($270,000).

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TABLE 1

SUMMARY COMPARISON OF ALTERNATIVE PLANS (Cont'd)

	Alternative 1 Do Nothing	Alternative 2 Flood Plain Management Alone	Alternative 3 Flood Plain Management with Additional Flood Control Storage at Upper Baker Project
ENVIRONMENTAL QUALITY			
Retains agricultural open green space.	NO	YES	YES
Disrupts land/river interface.	NO	NO	NO
Increases siltation along Baker Lake shoreline.	NO	NO	YES
Disrupts fish habitat along Skagit River.	YES	NO	NO
Reduces sockeye salmon spawning losses in Baker Lake.	NO	NO	YES
Improves water quality during floods by reducing water ponded and relieving overloaded storm and sanitary sewers.	NO	NO	YES
Compatible with National Wild and Scenic River designation of Skagit River in recreation status below mouth of Baker River.	NO	YES	YES

TABLE 1

SUMMARY COMPARISON OF ALTERNATIVE PLANS (Cont'd)

	Alternative 1 Do Nothing	Alternative 2 Flood Plain Management Alone	Alternative 3 Flood Plain Management with Additional Flood Control Storage at Upper Baker Project
REGIONAL DEVELOPMENT			
Increases net income to the area.	NO	NO	YES
Increases employment in area during plan implementation.	NO	NO	NO
Requires expenditure of construction materials from area for plan implementation.	NO	YES 1/	YES 1/
Encourages population increase on flood plain.	YES	NO	NO
Contributes to community development by reducing depressing economic effects of flood damages.	NO	YES	YES
Compatible with comprehensive plans of county.	NO	NO	YES
Reduces expenditures for flood fighting and repair of flood damages utilities.	NO	YES	YES

1/Flood proofing costs of future development.

TABLE 1

SUMMARY COMPARISON OF ALTERNATIVE PLANS (Cont'd)

	Alternative 1 Do Nothing	Alternative 2 Flood Plain Management Alone	Alternative 3 Flood Plain Management with Additional Flood Control Storage at Upper Baker Project
REGIONAL DEVELOPMENT (Cont'd)			
Encourages municipal expenditures for improvement of community facilities (streets, sidewalks, utilities, parks, etc.)	NO	NO	YES
SOCIAL WELL-BEING			
Improves level of flood protection.	NO	NO	YES (99,450 acres)
Requires relocation of residences.	NO	NO	NO
Requires relocation of other buildings.	NO	NO	NO
Increases level of flood protection for public facilities and services.	NO	NO	YES
Retains option for public use of Skagit River shoreline.	NO	YES	YES
Reduces flood fighting operations.	NO	YES	YES

TABLE 1

SUMMARY COMPARISON OF ALTERNATIVE PLANS (Cont'd)

	Alternative 1 Do Nothing	Alternative 2 Flood Plain Management Alone	Alternative 3 Flood Plain Management with Additional Flood Control Storage at Upper Baker Project
OTHER EVALUATION CRITERIA			
Plan is most acceptable to local governmental agencies.	NO	NO	YES
Planning objectives of flood damage reduction met to some extent.	NO	YES	YES
All investments necessary for full attainment of plan have been agreed to.	NA	NA	NA
Achieves planning objectives in least costly manner.	NO	NO	YES
Average annual benefits exceed average annual costs.	NA	YES	YES
Geographic area considered is relevant to planning objectives.	YES	YES	YES
Area could be easily restored to base conditions after plan has been implemented.	NA	NA	NA

With alternative 3 nearly 100,000 acres of urban and agricultural lands would experience a limited reduction in flood hazard during the winter flood season. Average annual flood damages in the year 2027 would amount to $4,819,000 with the additional flood control space at Upper Baker project or about 24 percent less than that expected under alternative 2. For additional flood control storage at Upper Baker project average annual existing benefits of $1,004,000 ($1,127,000 with future benefits) exceed the average annual costs of $434,000, giving a benefit-cost ratio of 2.3 to 1 (2.6 to 1 with future benefits). This alternative would achieve the planning objectives.

Other Flood Damage Reduction Proposals

The study reflected in this report was not intended to reformulate the basin flood control plan but merely to pursue implementation of a previously identified element.

A number of Skagit River basin flood damage reduction proposals have previously been considered during the Puget Sound and Adjacent Waters Comprehensive Study, including further upstream storage development on the Sauk River at a site near river mile 5. Raising of the existing levees downstream from Burlington and improving the channel at several locations are elements of the comprehensive plan adopted by the Pacific Northwest River Basins Commission, as well as Skagit County's Comprehensive Flood Control Plan. The Avon Bypass channel project (see page 19) also is an element of these plans.

National classification of the Sauk River as part of the National Wild and Scenic Rivers System would preclude a future storage project on the river and prevent Skagit County from exercising an option for additional flood protection. The county commissioners, reflecting the views of the basin residents, are desirous that flood control on the magnitude of 50-year protection be provided. This level of protection could only be achieved through a combination of measures, including additional storage at the Upper Baker project, and construction of the levee and channel improvement and the Avon Bypass or a dam on the Sauk River. As the majority of existing development lies on the Skagit River flood plain, evacuation would not be economically feasible nor socially acceptable.

Alternatives Considered Futher

At the April 1973 public meeting, general agreement was expressed on the desirability of additional flood control at the Upper Baker project (alternative 3). Subsequently, further detailed engineering, economic and environmental impact studies were limited to this proposal, with various amounts of storage space at the Upper Baker project examined. However, Alternative 2, Flood Plain Management Alone, was retained as an option.

The various volumes of additional storage space considered during detailed studies of alternative 3 are presented in the following tabulation.

ADDITIONAL FLOOD CONTROL SPACE AT UPPER BAKER PROJECT

Storage Space (acre-feet)	
Additional	Total
40,000	56,000
50,000	66,000
58,000	74,000
84,000	100,000

Reservoir drawdown schedules were developed for each variation of additional storage space. The schedules were based on a review of historical floods. Full flood control capacity from 15 November to 1 March would be required in order to assure that future winter flood discharges of the Baker River are controlled. Drawdown to provide flood control storage space in addition to the 16,000 acre-feet now available would begin on 1 November, the latest this drawdown should occur for flood control purposes. Earlier lowering of Baker Lake would increase power losses.

Selecting a Plan

Selection of the best plan for accomplishing additional flood damage reduction in the Skagit River basin at this time involved evaluating the economic and environmental impacts of

each of the Upper Baker project additional flood control storage volumes considered. Criteria outlined earlier were used in the formulation and evaluation process.

The various storage volumes were evaluated in terms of their effectiveness in controlling the 100-year flood event of the Skagit River at Concrete. Additional storage of 58,000 acre-feet, or total flood control storage of 74,000 acre-feet, was found to produce maximum net benefits (benefits over costs).

Current environmental impacts of the Upper Baker project would not be significantly altered by any of the various flood control storage schemes considered. Baker Lake has been drawn down as much as 64 feet below full pool within the past 4 years for hydroelectric power generation purposes. Maximum required drawdown below full pool considered during studies of alternative flood control storage volumes was about 23 feet to provide 100,000 (84,000 additional) acre-feet of flood control storage.

The only departure from past project operation would be an earlier drawdown, which may help reduce sockeye salmon egg losses now occurring as a result of adult fish spawning along Baker Lake shoreline (above elevation 700) during fall and early winter months. Earlier drawdown should reduce deposition of fish eggs which later are exposed to the atmosphere. However, follow-up monitoring studies, as proposed in this report, would be required to verify this reduction.

Management by Skagit County and the State of Washington of the Skagit River flood plain would be required for any of the storage volumes considered. Even though additional flood control storage at the Upper Baker project would increase flood protection for the lower Skagit Valley, the potential for major flooding would remain. The level of protection provided Mount Vernon and some of the diking districts would be increased from the current 10-year recurrence interval to a 15-year recurrence interval.

After evaluating economic and environmental aspects of each variation in storage, 58,000 acre-feet of additional flood control storage at the Upper Baker project in combination with flood-plain management was found to be the best solution for reducing future flood damages in the Skagit basin. This proposal (discussed in more detail in "The Recommended Plan") is consistent with Skagit County's adopted comprehensive flood control plan and the Pacific Northwest River Basins Commission's Comprehensive Water and Related Land Resources plan for the Puget Sound area.

The Recommended Plan

The preceding section reviewed the various steps involved in plan formulation, identified the alternatives considered, and provided the basis for the selection of the recommended plan. The subsequent discussion presents a review of the alternatives in terms of National Economic Development and Environmental Quality objectives. This is then followed by a broad description of the recommended plan, including its accomplishments and effects, as well as its significant operational features.

National Economic Development Plan

The National Economic Development Plan is the alternative that maximizes national economic benefits while addressing the planning objectives. Examination of the three alternatives considered in plan formulation reveals that Alternative 3, Flood Plain Management with Additional Flood Control Storage at Upper Baker Project would produce maximum national benefits while meeting the planning objectives. Therefore, alternative 3 was selected as the National Economic Development Plan.

Environmental Quality Plan

The Environmental Quality Plan is the alternative which makes the most significant contribution to preserving, maintaining, restoring, or enhancing the cultural and natural resources of the study area and causes the least adverse environmental impact while meeting the planning objectives. Again, alternative 3 is selected as it most closely meets this criteria. Alternative 2, Flood Plain Management Alone, while having the attributes required to qualify for environmental quality plan, would not mitigate floods which are in themselves environmentally damaging nor would alternative 2 provide a potential for reducing sockeye salmon redd losses as does alternative 3. Alternative 1, Do Nothing, is actually a lessening of land use restrictions such that environmental degradation would be encouraged. Planning objectives would not be met by this alternative.

Selected Plan Description

Combined with the effective flood plain management program being implemented by Skagit County, communities within the Skagit basin, and the State of Washington, additional flood control storage at Baker Lake would be the first major new element in Skagit County's comprehensive flood control plan. The Federal Power Commission license for the Upper Baker project contains provisions for additional flood control. Accordingly, the only action now required is for Congress to authorize Federal compensation of Puget Power for annual power losses that may result from the additional flood control. There are no actions required on the part of Skagit County or other local entities necessary to implement the proposal discussed herein, except to reaffirm their intention of continuing sound flood plain management practices. Skagit County Commissioners did this in a letter presented at the 8 April 1975 public meeting (see appendix 2).

The recommended plan includes the following features:

a. Drawdown of Baker Lake from 1 October to 1 November to provide 16,000 acre-feet of storage (El. 720.6) as replacement for valley storage lost when the project was constructed.

b. Additional drawdown of Baker Lake from 1 November to 15 November to reach a level at which a total of 74,000 acre-feet of storage capacity (El. 707.8) would be available for flood control.

c. Storage space of 74,000 acre-feet reserved until the first of March, except when regulating for flood control. Puget Power could still draw the reservoir below elevation 707.8 during this period for power production purposes. The required flood control storage capacity would be gradually reduced during March to permit Puget Power to refill to full pool, elevation 724, by 1 April.

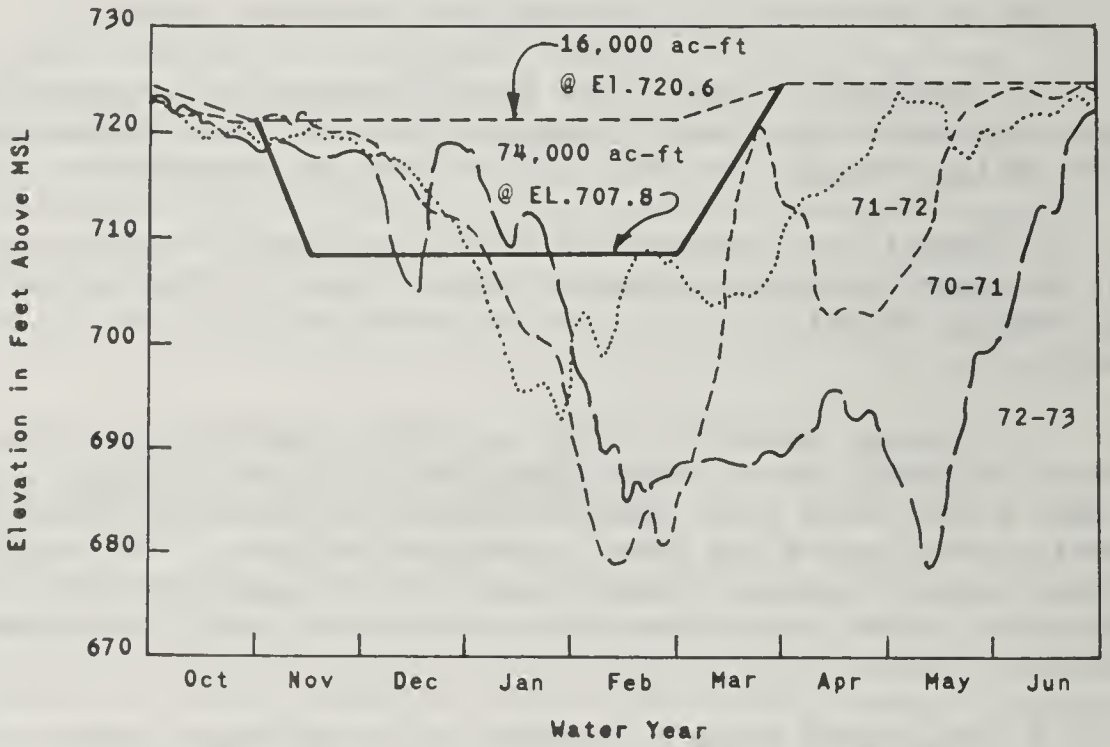
d. The Baker River's discharge into the Skagit River at Concrete regulated to a maximum of 5,000 c.f.s. (present power generation capacity of Upper Baker project) whenever the Skagit River is forecast to reach 90,000 c.f.s. at gage near Concrete. (located below mouth of Baker River).

e. Flood plain management by Skagit County and communities of Burlington, Mount Vernon, etc., consistent with the State of Washington Flood Control Zone Act of 1935 and the State of Washington Shoreline Management Act of 1971, as well as requirements of the Department of Housing and Urban Development, Flood

Insurance Administration. Upper and Lower Baker project are shown in the following photo.

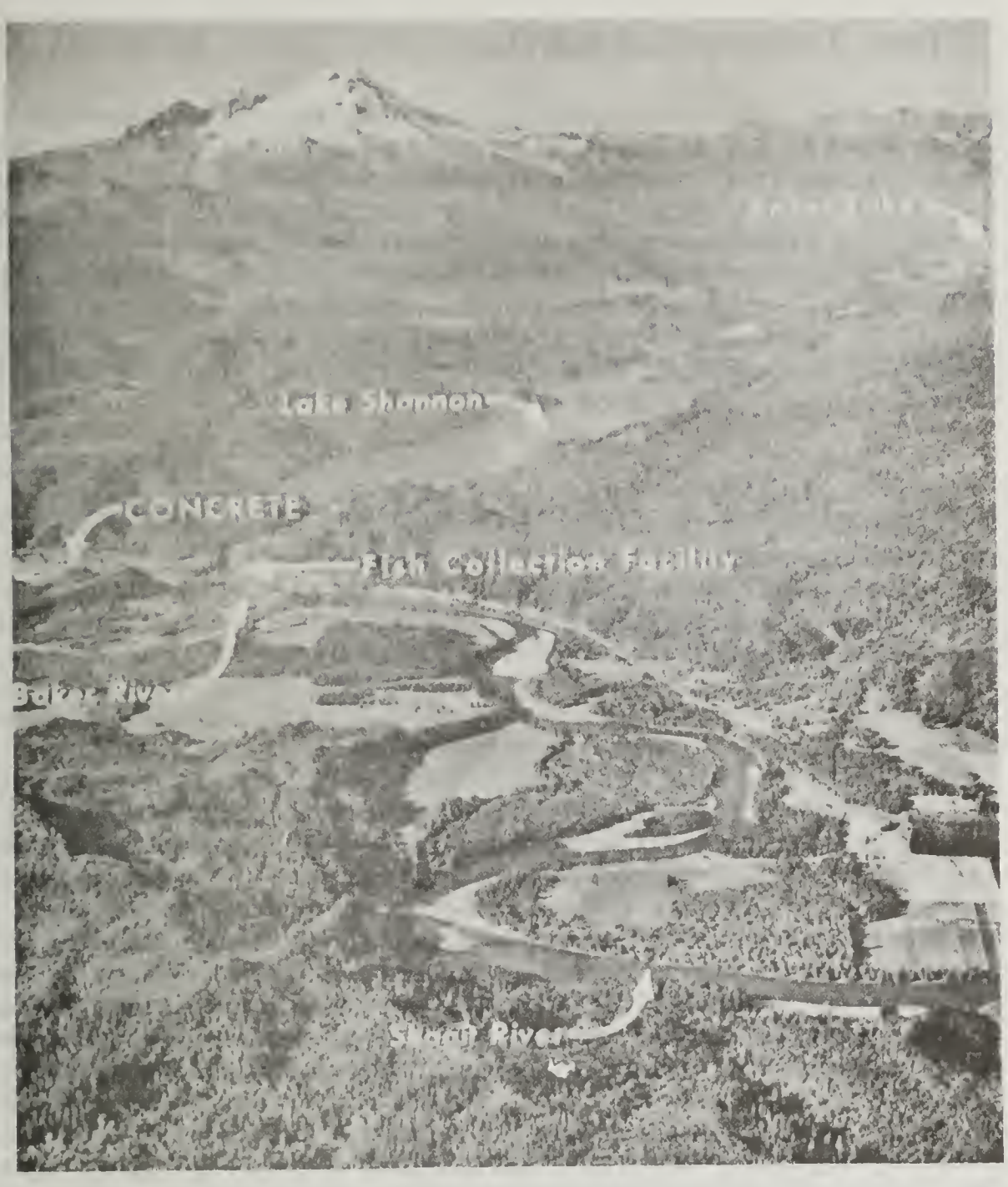
The area that would be benefited by the plan is that portion of the Skagit River flood plain located below the confluence of the Baker River, extending down to Padilla and Skagit Bays. This is shown on plate 1.

Puget Power would operate the Upper Baker project as directed by the District Engineer, Seattle District, Corps of Engineers, to regulate floods consistent with the 74,000 acre-foot flood control rule curve shown below.



UPPER BAKER PROJECT, RESERVOIR ELEVATION

(HISTORICAL DRAWDOWN AND FLOOD CONTROL RULE CURVES UNDER 16,000 ACRE-FEET (EXISTING) AND 74,000 ACRE-FEET (PROPOSED CONDITIONS)



View of Upper and Lower Baker Projects near Concrete, Washington

Plan Accomplishments

The major benefits that will result from the recommended plan are reduction of existing and future damages throughout the Skagit River flood plain, including the more intensively developed areas of Mount Vernon, Burlington, Sedro Woolley, and La Conner. The change in operation of the Upper Baker project would reduce floodflows and attendant damages on approximately 99,450 acres of land during a 100-year flood event. Approximately 80,250 acres would be benefited by the project during a 10-year event. The land-use distribution in the 10- and 100-year flood plains is shown in the following tabulation:

Land Use	10-Year Flood (acres)	100-Year Flood (acres)
Residential	1,000	1,600
Commercial/industrial	750	1,050
Roads & public facilities	2,400	3,200
Agricultural	71,800	87,200
Other	4,300	6,400
Total	80,250	99,450

The Baker project would reduce the $4,246,000 in average annual damages under 1974 prices and conditions by an estimated $1,004,000, or 24 percent. This reduction is viewed as the flood prevention benefits that would have been derived by the project if it would have been operated in 1974 as proposed in this report. Assuming the project operation change actually occurs in 1977, the flood prevention benefits in that year would be $1,024,000. An additional average annual benefit of $103,000 has been added to the base year benefit of $1,024,000 to reflect anticipated future growth in damages.

The total average annual flood prevention benefits of $1,127,000, which would accrue from the recommended plan, are well distributed over the entire flood plain. Over 3,600 separate ownerships were identified from a review of the Skagit County tax assessor's rolls.

Effects of the Plan on Environment

The primary effect of the recommended plan would be to increase the level of flood protection over nearly 100,000 acres of agricultural, residential, and commercial properties lying in the Skagit River flood plain below the mouth of the Baker River. Because substantial flood threat would still remain, minimal increase in development of the flood plain is anticipated as a result of the plan. While the peak discharge of the 100-year Skagit River flood event under current conditions would be reduced by 18,000 c.f.s. at Mount Vernon, the amount of land area covered by the regulated 100-year flood would not appreciably change due to the nature of the flood plain itself.

At the Upper Baker project, no change in physical features is called for by the recommended plan. Maximum operating level would still be elevation 724; the only difference is that the reservoir would be drawn down earlier than has been experienced in the past, in order to insure that flood control storage space is available when needed. Maximum reservoir drawdown, under the proposed flood control rule curve, is not expected to be any greater than has been experienced historically for hydroelectric power generation. If this facility is operated more as a peaking plant, as currently expected, the drawdown should become less severe. During high run years, some of the sockeye salmon which are transported into Baker Lake from a fish collection facility located below Lake Shannon may be benefited by the change in project operation.

The Washington Department of Fisheries operates a fish spawning facility above the lake to compensate for spawning beds inundated at the time the project was constructed (see plate 2). Whenever a sockeye salmon run exceeds the capacity of the spawning facilities, some natural spawning occurs along the shore of Baker Lake during October and November. Normally, the reservoir is above elevation 720 during this spawning period. Significant drawdown for hydroelectric power generation generally begins in December, which has, in years of large runs, resulted in exposed sockeye salmon redds and attendant egg losses. The proposed project operation change calls for an earlier drawdown than has been the case in the past; consequently, some reduction in the amount of salmon egg losses should result as adult fish are encouraged to seek out tributary streams for spawning.

During the drawdown period, the discharge of the Baker River would be increased an average of 1,900 c.f.s. Whenever natural inflows to the lake are less than 3,100 c.f.s. (the hydraulic capacity of the Upper Baker generating plant is 5,000 c.f.s.), the drawdown would be entirely accommodated through the turbines. When lake inflows equal or exceed 3,100 c.f.s., the reservoir drawdown would result in water being discharged over the spillway. However, the peak discharge over the spillway under a flood event would be considerably less under the recommended plan than would be the case under existing operating procedures. The relatively small increase in discharge during reservoir drawdown is not expected to result in any significant adverse impacts.

A separate draft environmental impact statement is being submitted with this report. It covers in detail the environmental considerations concerning the recommended plan and alternatives.

Other Plan Effects

Intangible benefits associated with the diminished flood potential are improved public health, reduced risk to human life, and increased morale of the people living in the flood plain.

Project Operation

The Upper Baker project would be operated during the winter flood season in accordance with agreement reached between the U.S. Army Corps of Engineers and Puget Sound Power and Light Company (Puget Power). The project reservoir would be drawn down in accordance with the 74,000 acre-foot rule curve shown on page 43.

Federal Power Transfer and Reimbursement

Power losses that would occur as a result of lower reservoir elevations would be computed in accordance with the agreement and Puget Power compensated with power in kind from the Federal

system by the Bonneville Power Administration. Bonneville Power has stated that the relatively small amount of power required to compensate Puget Power can be made available from the Federal system without jeopardizing other users.

The revenues foregone by Bonneville Power Administration as a result of the power transfer would be considered a nonreimbursable Federal flood control cost. The Corps' annual obligation to Bonneville Power can be effected by an offsetting reduction in charges to power at one of the Corps' projects in the Federal Columbia River Power System for which Bonneville Power is the marketing agency. It is proposed that the annual credit be made by reduction in the (power) operation and maintenance charges at Chief Joseph Dam, Rufus Woods Lake, Washington, project, a hydroelectric power project on the Columbia River, constructed and operated by the Seattle District, Corps of Engineers. This would preclude the need for an annual appropriation to the Corps for transfer to Bonneville Power.

Economics of Recommended Plan

Methodology

Tangible economic justification of the recommended plan can be demonstrated by comparing the average annual costs with the average annual benefits which would be realized from the proposal over a 100-year economic period of analysis. The recommended plan involves storage. Storage projects, because of long physical lives and large investments, are normally given 100-year economic lives. This economic life was found to be reasonable in that the remaining physical life of the Upper Baker project was assessed to be in excess of 100 years.

Costs

The economic evaluation of annual power losses resulting from the recommended plan was based on the cost of providing replacement power from new alternative powerplants, similar to the evaluation

of power benefits attributable to new hydropower projects. Also included in the average annual cost was allowance for administration of the additional flood control at the Upper Baker project, the cost of preparing a reservoir regulation manual and follow-up environmental monitoring studies. An interest rate of 5-7/8 percent was used in discounting future costs.

Puget Power performed the power loss evaluation studies based on flood control rule curves provided by the Seattle District, Corps of Engineers. Power loss evaluation computations performed by Puget Power were reviewed and checked by the Corps of Engineers and the Bonneville Power Administration (see Appendix 2, Bonneville Power Administration letter dated 24 June 1974) to insure that the computed average annual losses were reasonable. Puget Power analyzed power losses (capacity and energy) associated with three cases of additional storage by comparing the power that could be produced if the existing (16,000 acre-foot) flood control rule curve were followed with the power production possible under rule curves developed for each of the three cases. The average annual value of lost power was based on Federal Power Commission established unit costs for alternative power production plants having similar capacity factors on the Upper and Lower Baker projects. For this proposal, values reflected a thermal power project having 75 percent public (non-Federal) financing at 7-1/4 percent interest rate and 25 percent private financing at 10 percent interest rate. The following tabulation shows the evaluation for the recommended plan (58,000 acre-feet additional storage).

Capacity:	(6,300 kw maximum quantity) x ($64.29 per kw/yr) =	$405,000
Energy:	(1,117 kw x 8,760 hours)($.00173/kw-hr) =	17,000
Total value of power lost:		422,000
Flood control administration costs:		12,000
Total average annual costs:		$434,000

Benefits

Benefits of the recommended plan would be the reduction in future flood damages throughout the Skagit River flood plain, downstream from the mouth of the Baker River. Future average annual flood damages prevented represent the difference in average annual flood damage that would be expected without the

project change and residual average annual damages which would exist with the change. Future average annual flood damages in the Skagit basin were assessed on the basis of the existing level of development and the expected increase in development in the absence of the additional flood control storage at Upper Baker project but with effective flood plain management.

Average annual flood prevention benefits are based on July 1974 prices and a 100-year period of analysis (1977-2077). Average annual benefits are estimated at $1,127,000. Beneficiaries of this additional flood control for the Skagit River basin are widespread, including residents of the developed communities as well as agricultural areas.

Justification

A comparison of average annual benefits with average annual costs is shown in the tabulation below for the recommended plan. Although intangible benefits and possibly tangible secondary benefits may accrue to the national economy, only tangible primary benefits are represented in the tabulation.

AVERAGE ANNUAL COSTS AND BENEFITS

Average annual costs:	$434,000
Average annual benefits:	$1,127,000
Benefit-cost ratio:	2.6:1

Division of Plan Responsibilities

Flood plain management measures such as zoning and building codes and floodproofing of individual structures are currently being undertaken by local and state governments. The recommended plan requires continuation of these practices. The Corps of Engineers has and continues to provide information on the flood hazard in the Skagit River basin to enable local and state governments to implement flood plain management.

Article 32 of the Federal Power Commission license for the Upper Baker project enables operation of Upper Baker project for flood control. Consequently, no license change would be required

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for implementation of the recommended plan. However, Congressional authorization is required to allow Federal compensation of Puget Power for power losses that would result from the additional flood control. The Corps of Engineers and Bonneville Power Administration would share in the responsibility for carrying out the plan. Puget Power would be required to operate the project in accordance with the agreement reached with the U.S. Army Corps of Engineers, and to compute associated power losses for use by the Corps of Engineers and Bonneville Power in providing replacement power. The Federal agencies would be responsible for verifying the correctness of the computed losses with the Federal Government to bear the cost of providing additional flood control. Actual cost in terms of power revenues foregone would depend on the power losses experienced and the Bonneville Power rate schedule in effect during any given year. Based on the EC-6 rate in effect in May 1975, Bonneville Power (BPA) computed the power revenue that would be foregone, given the capacity and energy losses used in this report, at $56,000. (See appendix 2 for BPA letter dated 11 April 1975.)

Plan Implementation

Steps necessary to realizing implementation of the recommended plan are as follows:

a. Review of this report by higher Corps of Engineers authorities including the North Pacific Division, Board of Engineers for Rivers and Harbors, and the Office of the Chief of Engineers.

b. The Chief of Engineers would then seek formal review and comment by the governor of the State of Washington and interested Federal agencies.

c. Following the above State and interagency review, the final report of the Chief of Engineers would be forwarded by the Secretary of the Army to Congress, subsequent to his seeking comments of the Office of Management and Budget regarding the relationship of the proposal to the program of the President.

d. Congressional authorization of Federal compensation of Puget Power would then be required. This would include appropriate review and hearings by the Public Works Committees.

e. If Federal compensation is authorized, the Chief of Engineers would then include funds within his operation and maintenance budget to allow for negotiation of a power loss evaluation agreement with Puget Power and preparation of a reservoir flood control operation manual.

f. Following negotiation of the agreement, the project would be operated for flood control with resulting power losses compensated in time and kind through transfer of power from the Bonneville Power system.

The schedule for carrying out the above steps cannot be accurately estimated because of the variables in review and funding processes. However, once Federal compensation of power losses is authorized, flood control at the Upper Baker project should be possible, either the immediate winter season after authorization or the following.

Views of Non-Federal Interests

The recommended plan of improvement was coordinated with the following State of Washington agencies: Department of Ecology, Parks and Recreation Commission, Highway Commission, Department of Fisheries, Department of Game, Department of Natural Resources, Department of Commerce and Economic Development, and Office of Program Planning and Fiscal Management; as well as Skagit County and the Skagit Regional Planning Council. Also, through a public involvement program utilizing public brochures, the input of various organizations was sought including but not limited to the following: Washington Environmental Council, Audubon Society, Leagues of Women Voters, Pacific Northwest Waterways Association, State of Washington Land Planning Commission, all the drainage and diking districts lying within the Skagit River flood plain, Burlington Northern Railroad and Union Pacific Railway, Sierra Club, Skagit Valley Grange No. 620, Skagit Conservation District, Skagit Environmental Council, the Izaak Walton League of America, and Huxley College of Environmental Studies.

Correspondence from those interests expressing views on the study findings are contained in appendix 2 and summarized here. Also, presented here is a brief of oral statements given at the final public meeting held in Mount Vernon on 8 April 1975.

- State of Washington

Comments representing the position of the state on the recommended plan were provided by the Director, Department of Ecology by letter dated 14 April 1975. Copies of the draft authorization report and draft environmental impact statement on Additional Flood Control at Upper Baker project were transmitted to the Department of Ecology in February 1975 as well as the Office of Program Planning and Fiscal Management, Office of the Governor. The latter office distributed copies of the two documents for review and comments to the other appropriate departments and commissions. Conclusions reached by the State Department of Ecology, following the coordinated review are quoted as follows:

"We have reviewed the Draft Authorization Report, Public Brochure, and the Draft Environmental Impact Statement for the Upper Baker project, Skagit River Basin and concur with the findings and recommendation contained therein."

"As you are aware, the Department of Ecology is designated by Governor Evans to represent the State on these matters. In a coordinated review we have found no opposition to the recommended alternative and find that it will generally increase multiple-objective benefits (except for minor power losses)."

"We, therefore, encourage early implementation of Alternative Three-Flood Plain Management with additional flood control storage at the Upper Baker Project."

● Skagit County Board of Commissioners

By letter dated 7 April 1975 the board concurred in the findings and recommendations of the draft report. Further the county agreed to:

"A. Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood-carrying capacity or in any way reduce the effectiveness of flood control operations of the Upper Baker Project.

B. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

C. At least annually, inform affected interests regarding the limitation of the added protection afforded by the project."

● Skagit Regional Planning Council

In letter dated 3 April 1975 the council agreed with the study findings and expressed the view that additional flood storage at Upper Baker project together with flood plain management and construction of the previously authorized (1966) Skagit River levee and channel improvement project would provide the minimum protection acceptable to residents of the Skagit Valley.

● Skagit Conservation District

The Board of Supervisiors in letter dated 3 April 1975 expressed support for alternative 3, viewing it as a beginning of an overall comprehensive flood control program for the Skagit. A request was made for a Corps of Engineers feasibility study of a storage project on the Sauk River prior to Congressional action on recommended classification by the U.S. Forest Service of that stream as part of the National Wild and Scenic River System.

- The Izaak Walton League of America

By letter dated 15 April 1975 the Greater Seattle Chapter of the league concurred after reviewing the draft authorization report that the effect of additional flood control storage space at Upper Baker project would be minimal and that very little adverse effect would result on recreation.

- Skagit Environmental Council

The president of the council, in letter dated 24 March 1975, reported that the Board of Directors had voted on 20 March 1975 to approve alternative 3. However, they expressed strong opposition to a flood control storage project on the Sauk River.

- Puget Power and Light Company

In letter dated 21 May 1975 the company reiterated a statement read at the 8 April 1975 public meeting, noting that their position throughout the Corps' study has been to aid in whatever way necessary to bring about better flood control in the Skagit Valley. The company endorsed alternative 3 and pledged to work with the Corps of Engineers in implementing the flood control program as soon as possible.

- Other Comments

Views of other organizations expressed at the 8 April 1975 public meeting or in response to the final draft public borchure are summarized as follows:

Mount Vernon Argus newspaper publisher applauded alternative 3 and expressed desire for early action in its complementation.

District 15 Dike Commissioner felt alternative 3 to be the least expensive mitigation measure possible at this time.

Private citizen of Anacortes, Washington expressed approval of alternative 3 but was strongly against a dam on the Sauk River.

Private citizen of Mt. Vernon, Washington felt that with alternative 3 and the authorized Skagit River Levee and Channel Improvement project ample flood control would be available.

Private citizen of Redmond, Washington supported alternative 3, viewing it as a logical extension of a multiple use concept of Baker Lake reservoir.

Review by Other Federal Agencies

The recommended plan of improvement was coordinated with the following Federal agencies: Federal Energy Office, Department of Health, Education, and Welfare, Community Service Administration, Bureau of Reclamation, National Parks Service, Environmental Protection Agency, Federal Power Commission, Department of Housing and Urban Development, U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Outdoor Recreation, Soil Conservation Service, Federal Highway Administration, Department of Interior (Regional Coordinator), Bonneville Power Administration, National Marine Fisheries Service, Department of Commerce, Bureau of Mines, Bureau of Land Management, Bureau of Indian Affairs, Geological Survey, and the Advisory Council on Historic Preservation. Each of the foregoing were furnished a copy of the draft authorization report and draft environmental impact statement in February 1975 for review and comment.

Letters received by those agencies expressing views are contained in Appendix 2 and summarized or quoted here.

- Bonneville Power Administration

The Administration, by letter dated 22 April 1975 stated the bureau has no comments or objections to the draft authorization report.

- U.S. Forest Service

In letter dated 11 April 1975 the Regional Forester for Region 6 stated: "The proposed action [alternative 3] is compatible with National System status for the Skagit [River]. It is addressed and supported by our forthcoming draft environmental statement on the Skagit River Study."

- Federal Power Commission

The Regional Engineer by letter dated 23 April 1975 did not take a position on the recommended plan but merely provided editorial comments. However, it was noted that the plan is part of FPC Licensed Project No. 2150.

- Bureau of Mines

By letter dated 31 March 1975 the Chief, Western Field Operation Center stated: "The proposed modification in the operation of Upper Baker Dam and Reservoir for flood control purposes would not adversely affect mineral development in

the Skagit River basin." Increased steam venting from Mt. Baker was felt to warrant discussion in the environmental impact statement and the final report. This has been done.

- U.S. Fish and Wildlife Service

No comments were made on the draft report in letter dated 2 April 1975. The report of the U.S. Fish and Wildlife Service in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) was furnished by letter dated 20 September 1974 and is included within appendix 2.

- National Marine Fisheries Service

No comments were received on the draft report. However, by letter dated 21 May 1974 the Program Director asked for earlier drawdown than proposed under alternative 3. The Seattle District response in letter dated 10 June 1974 presented the Corps of Engineers position that earlier drawdown for fishery enhancement purposes was beyond the scope of the FPC project license and therefore, beyond the scope of the Corps' study. However, the Corps of Engineers would be willing to assist Federal and State Fish and Wildlife agencies in any future studies of the National Marine Fisheries Service proposal. The Service's response in letter dated 26 June 1974 together with the previous mentioned correspondence is contained in appendix 2. Any increase in drawdown over that required by the flood control rule curve proposal under alternative 3 would result in additional power losses. Fishery enhancement benefits must exceed the value of foregone power production in order to justify project operation change. This would require an evaluation of benefits by the appropriate fish and wildlife agencies and a FPC license change.

- Bureau of Land Management

By letter dated 18 March 1975 the Acting State Director's only comment was a suggestion for greater discussion of the impact of alternative 3 on the potential classification of the Skagit River under the National Wild and Scenic River System. This has been done.

- Bureau of Indian Affairs

The Assistant Area Director by letter dated 10 April 1975 noted that alternative 3 should not diminish and may enhance the fishery environment. However, the director felt it was important to conduct the follow-up monitoring studies as proposed in this report.

- Bureau of Reclamation

In his letter of 10 April 1975 the Assistant Regional Director stated the bureau had found no problems with the draft authorization report which would give rise to significant comment.

- U.S. Environmental Protection Agency

The Director, Office of Federal Affairs, Region X in letter dated 9 April 1975 "*** no significant environmental impacts due to the proposal are foreseen." The draft environmental impact statement was classified LO-1, LO (Lack of Objections) 1 (Adequate Information).

- Bureau of Outdoor Recreation

By letter dated 9 April 1975 the Regional Director stated "*** review of the authorization report reveals the proposal would have minimum impact on recreation facilities and opportunities."

- Advisory Council on Historic Preservation

Director, Office of Review and Compliance in letter dated 20 March 1975 determined that draft environmental statement appears adequate.

- U.S. Geological Survey

By letter dated 15 April 1975 the Acting Director stated that the draft authorization report was found to be adequate and generally accurate in the assessment of the impact of the proposed actions on water resources of the area. Several editorial comments were provided which have been reflected in this report.

- National Park Service

Associate Regional Director, Cooperative Activities in letter dated 9 April 1975 asked that the Washington State Historic Preservation Officer be consulted and the results of the consultation documented in the final environmental impact statement. This has been done.

- Pacific Northwest River Basins Commission

Chairman of the commission, in letter dated 5 June 1975, concurred with the conclusions of the study and found that they are consistent with the comprehensive Puget Sound Adjacent Waters Study completed under the auspices of the Commission.

Effects Assessment

The following assessment summary is provided to demonstrate that all significant adverse and beneficial effects of the recommended plan have been fully considered, in compliance with section 122 of the River and Harbor and Flood Control Act of 1970:

Noise and air pollution. None, as no construction is involved in implementing the proposal.

Water pollution. Releases from Baker Lake would be increased an average of about 1,900 c.f.s. over existing conditions during the period of additional drawdown between 1 and 15 November each year. These higher flows would not reduce the quality of water in the Skagit system now regarded as excellent and may actually improve water quality of lower reaches of the Skagit River through increased flushing. Water pollution would be diminished to the extent improved flood control reduces damage to municipal and industrial waste collection and treatment facilities.

Destruction of manmade resources. None.

Esthetic values. Earlier drawdown of Baker Lake would expose a greater amount of unsightly lake bottom during November and early December than has been the case in the past. Also, some minor amount of additional turbidity near lake edges is expected. However, this effect is expected to be minor due to the normally low recreational use of the lake area during these winter months.

Disruption of community and regional growth. The proposed action is not expected to have any significant effects on population growth or community development within Skagit County. The level of flood protection made possible by alternative 3 is not sufficiant to reduce current land use restrictions applicable to flood hazard areas.

Public facilities and services. The cost of flood-related community services and facilities should decrease with implementation of alternative 3. A portion of local and State funds which would otherwise be appropriated for flood fighting, rescue, and repair may become available for the improvement of other community services and facilities.

Employment. Because no construction is required, local employment or income levels would not be impacted to an assessable degree. Temporary disruption of employment due to flood repair should decrease slightly.

Tax losses. Only a minimal impact would result on residential and agricultural property valves and likewise impacts on commercial and industrial property values are expected to be moderate. Tax revenue would rise to the extent that assessed valuation of all affected property increases.

Property value loss. None.

Displacement of persons and businessess. None.

Fish and wildlife values. Present Baker Laker reservoir operation results in some sockeye salmon redd losses at lake elevations above 700 feet. At the beginning of the sockeye spawning season, in early fall, the lake is normally near full. In years of large salmon runs, when the artifical spawning areas provided by the original project are at capacity, some lake shore spawning occurs. Later winter drawdown for hydroelectic power production exposes the eggs resulting in a lost fish propigation potential. Earlier drafting of Baker Lake reservoir, as called for under the recommended plan, may reduce this salmon loss potential. Follow-up environmental monitoring studies would provide a basis for evaluating this possibly. As reservoir operating levels would not be increased and no construction is required, impacts on wildlife resources should be negligible.

Statement of Findings

I have reviewed and evaluated, in light of the overall public interest, the documents concerning the recommended plan, as well as stated views of other interested agencies and the concerned public, relative to the various practical alternatives to additional flood control storage at the Upper Baker project in order to accomplish flood damage reduction in the Skagit River basin.

The possible consequences of the various alternatives have been studied according to environmental, social well-being, and economic effects, including regional and national development and engineering feasibility.

In evaluation of the recommended plan and alternatives the following points were pertinent:

Environmental considerations. The recommended plan (Environmental Quality Plan) would maintain and possibly enhance environmental values in the Skagit River basin. Only a change in Upper Baker project operation would be needed with no significant environmental effects expected. Possibly some limited improvement in sockeye salmon production over existing conditions would be gained incidental to flood control drawdowns. Adult fish may be discouraged from spawning in the lake bottom which is later exposed. Flood plain management aspects of the plan should help insure that open space and green belt areas are retained in the Skagit Valley. Flood plain management alone, while helpful in steming the growth of flood damages and preserving the natural environment, would not have the attributes that the recommended plan has.

Social well-being considerations Skagit County, through its Board of County Commissioners, has long sought to reduce the flood damage potential in the Skagit River basin through affirmative action, including implementation of effective flood plain management practices. Their desire, which I have taken into careful consideration, is to reduce the flood threat and thereby improve the personal welfare, including health, safety, and peace of mind of citizens residing or owning property in the flood plain. In my opinion, the recommended plan is superior to all other alternatives considered in meeting the objectives of preservation and enhancement of the social well-being of the people.

Economic considerations. The recommended plan is also the National Economic Development Plan, in that it would provide greater net benefits than other alternatives considered. The storage volume and operating scheme selected for the recommended plan are consistent with the objectives of providing reliable and economically justified increased flood control for the Skagit River basin.

Other public interest considerations. The provision of additional flood control space at the Upper Baker project would require no modification of existing project facilities and therefore not place any demand on study area non-renewable resources. Also, implementation of the recommended plan would allow further planning to proceed in the form of preconstruction studies of the previously authorized Skagit River levee and channel improvement project. The latter is very much wanted by Skagit County. Together with additional flood control storage at Upper Baker project the minimum level of flood protection in the lower Skagit Valley would be increased from the current 3 years average recurrence interval to about 11 years for agricultural areas.

I find that the action proposed is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives; that any adverse

effects found to be involved are relatively minor and cannot be avoided by following reasonable alternative courses or action which would achieve the congressionally specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations of national policy; that the recommended action is consonant with national policy, statutes, and administrative directives; and that, on balance, the total public interest would best be served by the implementation of the recommendation.

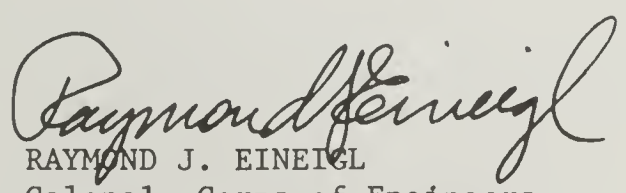
Recommendations

I recommend that the Upper Baker project be operated to provide additional flood control storage space as described in this report. Puget Sound Power and Light Company should be compensated by the Federal Government with power, in kind, for resulting hydroelectric power losses, provided that non-Federal interests agree to:

a. Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood-carrying capacity or in any way reduce the effectiveness of flood control operation of the Upper Baker project.

b. Publicize flood plain information in the areas concerned, and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain, and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

c. At least annually, inform affected interests regarding the limitation of the added protection afforded by the project.



RAYMOND J. EINEIGL
Colonel, Corps of Engineers
District Engineer

[First endorsement]

NPDPL-PF (1 Jul 75)
SUBJECT: Authorization Report for Additional Flood Control at Upper Baker Project

DA, North Pacific Division, Corps of Engineers, 210 Custom House, Portland, Oregon 97209 31 July 1975

TO: Chief of Engineers

I concur in the conclusions and recommendations of the District Engineer.

WESLEY E. PEEL
Brigadier General, USA
Division Engineer

PUGET SOUND AND ADJACENT WATERS, WASHINGTON

AUTHORIZATION REPORT FOR ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT, SKAGIT RIVER BASIN, WASHINGTON

Technical Report

APPENDIX 1

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SECTION B	RESOURCES AND ECONOMY OF THE STUDY AREA
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SECTION D	FORMULATING A PLAN
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SECTION G	DIVISION OF PLAN RESPONSIBILITIES

PREPARED BY THE
SEATTLE DISTRICT, CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

THE STUDY AND REPORT

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SECTION A

THE STUDY AND REPORT

1. Background information concerning authorization of the study discussed herein and a description of the investigations leading to this report are presented here as a useful introduction to the contents and findings of this document.

Purpose and Authority

2. The purpose of the study was to investigate the feasibility and desirability of providing additional flood control storage at the Upper Baker project, located on the Baker River about 9 miles upstream from its confluence with the Skagit River. Additional flood control storage at the hydroelectric project, owned and operated by Puget Sound Power and Light Company (Puget Power), is an early action element of the Comprehensive Water and Related Land Resources Plan adopted by the Pacific Northwest River Basins Commission in 1971 for the Puget Sound and Adjacent Waters study area. Economic feasibility was one of the major factors considered in developing the recommended plan, and therefore, was investigated in detail. Recommendations of the study are presented in the main report.

3. The study and report are in compliance with the Flood Control Act of 1962, Section 209, Public Law 87-874, which authorized the comprehensive study of Puget Sound and Adjacent Waters.

Scope of the Study

4. The study was limited to determining the feasibility and desirability of providing additional flood control storage at the Upper Baker project, located in the Skagit River basin. Various amounts of flood

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control storage capability at the Upper Baker project were considered along with the alternative of not providing additional flood control but merely relying upon existing State law and local ordinance to minimize future growth in flood damage potential. Advantage was taken of previous comprehensive investigations conducted by the Pacific Northwest River Basins Commission through the interagency Puget Sound Task Force. Selection of the recommended plan was made after considering all factors, including the expressions of concerned agencies, the State of Washington, and local interests. Studies were conducted to only the depth and detail needed to permit plan selection and to determine its feasibility.

Study Participants and Coordination

5. Seattle District, Corps of Engineers was responsibile for conducting and coordinating the study, formulating the recommended plan, consolidating information from studies of other agencies, and preparing this report.

6. The following provided input to the study:

U.S. Fish and Wildlife Service	National Marine Fisheries Service
U.S. Forest Service	Bonneville Power Administration
State of Washington	Federal Power Commission
	Puget Sound Power and Light Company

7. U.S. Fish and Wildlife Service and National Marine Fisheries Service, together with the Washington Departments of Fisheries and Game, investigated the possible impacts on fish and wildlife resources that could result from additional flood control at the Upper Baker project.

8. Bonneville Power Administration reviewed power loss study data developed by Puget Power in cooperation with the Corps of Engineers to verify that the computed energy and capacity losses were reasonable and computed the value of power revenues that would be foregone by the Federal Government in replacing the power losses.

9. U.S. Forest Service provided information from their National Wild and Scenic Rivers Study of the Skagit River and its principal tributaries.

10. State of Washington participated through the Departments of Ecology, Fisheries, and Game with the latter agencies providing study input on fish and wildlife impacts.

11. Federal Power Commission furnished information used in evaluating the economic cost of hydroelectric power losses associated with additional flood control at the Upper Baker project.

12. Puget Power computed power losses (capacity and energy) based on flood control operation of Upper Baker project following alternative drawdown and refill rule curves and supplied water quality data on Baker Lake and Lake Shannon.

13. All studies were coordinated with appropriate Federal and State agencies and local governments, including but not limited to the Bureau of Outdoor Recreation, U.S. Fish and Wildlife Service, Bonneville Power Administration, Soil Conservation Service, U.S. Forest Service, National Marine Fisheries Service, Federal Power Commission, Environmental Protection Agency, various departments and agencies of the State of Washington, Skagit County, and the communities and towns lying within the Skagit River flood plain. Public involvement and comments from various interest groups were solicited through public meetings and distribution of four drafts of a public information brochure. Such groups included the Sierra Club, Washington Environmental Council, Audubon Society, Leagues of Women Voters, and Skagit Valley Grange #620.

14. An initial public meeting was held in Burlington, Washington on 25 April 1973 following distribution of two drafts of the public brochure, which explained the study background and alternatives being considered. The public meeting was held to further afford local interests the opportunity to express their views and comment on the alternatives proposed for study. A third draft brochure was distributed after the 25 April meeting. Subsequently, a number of informal meetings were held with local interests, Puget Power, and Skagit County officials. Prior to that meeting a fourth draft brochure was distributed to all known interested parties containing the District's tentatively recommended plan. The final public meeting was held in Mount Vernon, Washington on 8 April 1975 to present study findings and the recommended plan.

The Report

15. In the interest of clarity of presentation and reference, this report has been arranged into a main report and three appendixes.

16. The main report is a nontechnical presentation of information obtained from feasibility studies of additional flood control at Upper Baker project. It is the basic document that presents a broad view of the overall study for the benefit of both general and technical readers. Included in the report are a description of the study area and existing improvements; the flood problems experienced in the past

and potential for significant damages in the future; previous planning, including other elements of a Skagit County's comprehensive flood control plan; formulation of the most suitable plan for additional flood control at this time; a summary of the plan's economics indicating the benefits, costs, and justification; the division of responsibilities between Federal and non-Federal interests; and recommendations for implementing the proposed plan.

17. Appendix 1 is a technical document organized in essentially the same sequence as the main report, but providing technical information required to support the findings and recommendations of the study.

18. Appendix 2 contains all correspondence pertinent to the study, which adds to the understanding of the basic report and technical documents.

19. Appendix 3 contains the final edition of a public brochure used to communicate information on the study and alternatives being considered, as well as providing a forum for public and agency comment and debate on the alternatives.

Prior Studies and Reports

20. The Puget Sound and Adjacent Waters Comprehensive Water and Related Land Resources Study, results of which are contained in a summary report and 15 supporting appendixes, provided the basis for the study reflected in this report. The comprehensive study, undertaken by a Federal-State interagency task force of the Pacific Northwest River Basins Commission, considered all water and related land resource problems and needs, including flood damage reduction. Skagit River basin was analyzed as one of 11 major river basins or island groupings comprising the Puget Sound study area.

21. Further flood control storage at the Upper Baker project was identified in the Puget Sound comprehensive plan as an early action element. Also contained with the flood control portion of the comprehensive plan were the Avon Bypass and Skagit River Levee and Channel Improvement projects, previously authorized by Congress in the Flood Control Acts of 1936 and 1966, respectively.

22. Prior reports completed by the Corps of Engineers involving flood control improvements in the Skagit River basin are tabulated below.

Report	Date	Improvements Considered	Recommendations
H.D. 125 69th Congress 1st Session	1925	Basin flood control	Survey of flood control
H. D. 187 73rd Congress 2d Session	1933	Basin flood control including Avon Bypass	Flood control improvements could not be recommended at that time
Preliminary Examination (not published)	29 March 1937	Basin flood control	Additional surveys for flood control were recommended
Survey Report (not published)	21 Feb 1952	Flood protection in delta area	Flood control improvements could not be recommended at that time
H. D. 483	30 Aug 1966	Basin flood control	Levee and channel improvement project along Skagit River, below Sedro Woolley, and modification of authorized Avon Bypass to permit Federal participation in recreation facilities

RESOURCES AND ECONOMY OF THE STUDY AREA

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SECTION B

RESOURCES AND ECONOMY OF THE STUDY AREA

1. The need for flood damage prevention and development and conservation of water resources is determined largely by activities related to the economic base of a region or river basin. The purpose of this section is to present data and information which describe the economic activities of Skagit County and the Skagit River flood plain. In terms of population characteristics, existing economic activity, and expected growth, Skagit County and the flood plain are quite similar. Important socioeconomic variables affecting these areas are also presented.

Natural Resources

Land Use

2. The Skagit-Samish basins comprise about 2 million acres, which include most of Skagit County, as well as parts of Snohomish and Whatcom Counties and a small portion of British Columbia, Canada. There are 1,110,000 acres of land in Skagit County with timberland covering about 848,000 acres, or about three-fourths of the land area.. Most of the timber is classified as commercial. Of the remaining land, approximately 142,000 acres are farmland, another 9,000 acres are urban, and 111,000 acres are alpine areas.

The entire valley floor of the Skagit River and the deltas of the Samish and Skagit Rivers comprise the flood plain. The Skagit River flood plain considered in this report lies west or downstream from the mouth of the Baker River, near Concrete, Washington. This portion of the 100-year flood plain covers 99,450 acres. The Baker River enters the Skagit about 32 miles east of Sedro Woolley. The major portion of the bottom land east of Sedro Woolley is in agricultural use, and the remainder is mostly uncleared or swampy.

Forests

3. In 1960 timber harvest in Skagit County was about 178 million board feet, of which about 84 million board feet (47 percent) came from privately owned lands. By 1972 log production increased to 297 million board feet, 156 million board feet (53 percent) of which came from privately owned land. This large increase is attributed in part to the harvesting of second growth Douglas fir and hemlock on private land. Most of the logs cut are moved by truck to pulp and lumber mills in Everett and Bellingham. In Skagit County the "value added by manufacturing" from lumber and wood products has averaged about 13 percent of total value added. Forest resources are relatively unimportant in the Skagit River flood plain.

Minerals

4. There are a wide variety of mineral resources in Skagit County, but only a few have been developed commercially. In 1970 the value of mineral production amounted to only $1.4 million, down from the $3.5 million production in 1960. This reduction is the result of a major cement establishment in the town of Concrete ceasing operations in 1969. The principal minerals extracted (in order of importance) are olivine, sand and gravel, stone, and soapstone. Very rich deposits of limestone and olivine are found in the upper Skagit Valley, and one of the few commercial strontium deposits in the United States is found near La Conner on Fidalgo Island.

Fisheries

5. The Skagit River has large migratory runs of the salmon and steelhead which constitute a significant part of both the sport and commercial fishery of the region. Both Indians and non-Indians commercially fish the Skagit River estuary and bay for salmon. Between 1956 and 1965 the average salmon catch for nonpink years (5 year average

- all even years) was 52,400 fish. 1/ During the same period the average catch for pink years (5 year average - all odd years) was 258,100 fish. 1/ Steelhead a sea-going rainbow trout has made the Skagit river famous for its sport fishing with over 20,000 of these fish harvested each year. In addition to the abundance of anadromous fish, a resident trout population in the Skagit River contributes to the sport fishery.

Industry

Agricultural

6. The climate is very mild in the western portion of the county and the lands fertile and highly productive. The bottom lands of the Skagit River flood plain require ditching and diking due to their close proximity to saltwater. Further up the Skagit River the land becomes less fertile and the variety of agricultural products grown is limited. Most of the farms are in the 68,000-acre fertile Skagit River delta. The number of farms in Skagit County has been decreasing while the average farm size has been increasing. The percentage of land in farms has been decreasing. Although the amount of land being farmed has decreased, the market value of all agricultural products sold has increased 65 percent from 1959 to 1969. The market value of all agricultural products sold in 1969 was $26 million. Over half of this total value was from livestock, poultry, and their products, followed in importance by crops. Vegetable farming has been increasing, due to pressures for greater and more intensive utilization of land, and there has been a diminution in the numbers of animal stock. Table B-1 summarizes some measures of agricultural activity over the past decade.

7. Existing crops in the flood plain that would be effected by the project are bulbs, hay, raspberries, strawberries, seed grass, winter wheat and winter barley. Bulbs contribute to over half of the monetary crop damage caused by flooding and in 1969 the market value sold totaled $959,000. Although acreage devoted to agriculture in Skagit County will probably lessen in the years ahead, the future of the industry is assured by rising productivity and by the proximity of the county to the expanding urban centers around Puget Sound.

1/These data show the contribution attributable to the Skagit River; however, it does not include quantities of salmon bound for the Skagit taken in the ocean or waters outside Skagit Bay.

TABLE B-1

SKAGIT COUNTY FARM INCOME AND SALES

FOR 1969 AND 1959

	1959	1969
Market value of all agricultural products sold	$15,890,942	$26,234,667
Average value per farm	8,953	24,985
Crops including nursery products and hay	NA	11,937,541
Specialty forest products	(1964) 83,989	19,696
Livestock, poultry and their products	9,167,984	14,277,430
Value of dairy products sold	(5,550,915)	(8,781,893)
Poultry products sold	(1,575,773)	(1,596,635)
Livestock and livestock products sold other than dairy	(2,041,296)	(1,805,482)
	Head	Head
Cattle and calves	41,160	37,038
Milk cows	16,367	13,274
Hogs and pigs	620	162
Sheep and lambs	1,527	354

Source: Washington State University, College of Agriculture, Skagit County Agriculture: An Economic Mainstay, 1972, p. 4.

Manufacturing

8. Manufacturing activity in Skagit County is primarily associated with the processing of the natural resource products of the area. Total manufacturing employment was 3,450 in 1970. The principal activities are lumber and wood products and food processing. In constant dollars, value added by manufacture for Skagit County increased at an annual rate of 3.6 percent between 1958 and 1972, compared to a constant dollar annual increase of 2.7 percent for the State over the same period. Manufacture of lumber and wood products has been the mainstay of the economy in Skagit County and in 1970 represented 37 percent of the total manufacturing employment. 1/ The impact of forest products on Skagit County is further indicated in the 1974 edition of the Directory of Washington Manufacturers, which shows that of the 107 manufacturing firms in the county, 45 percent are in lumber and wood products.

9. Manufacturing activity in the flood plain is limited to several food processing establishments and a few small wood products firms. Damaged machinery and business interruptions are the two outstanding types of losses experienced by manufacturing plants. Floodwaters also damage foundations, superstructures, building improvements, office furnishings and records, stocks of raw materials and finished goods, outbuildings, vehicles and grounds.

Retail Sales

10. Mount Vernon, which is partially located in the flood plain, is the center of retail trade for Skagit County and in 1967 accounted for 46 percent of total retail sales for the county. Portions of Mount Vernon and Burlington are located in the flood plain and have experienced rates of growth in retail sales between 1963 and 1967 equal to or slightly greater than Skagit County. In constant dollars, retail sales in Skagit County increased at an annual rate of 2.3 percent between 1954 and 1967. During this same time period, retail sales for the State of Washington rose at an average constant dollar rate of 3.3 percent. Retail sales for Washington, Skagit County, Mount Vernon, and Burlington are shown in table B-2.

1/Washington State Employment Security Department.

TABLE B-2

RETAIL SALES

WASHINGTON AND SKAGIT COUNTY 1954-1967

(1967 $)

	$1,000				Average Annual Increase
	1954	1958	1963	1967	1954-1967
Washington	$3,569,789	$3,947,526	$4,408,527	$5,465,566	3.3%
Skagit Co.	68,578	75,942	79,669	91,917	2.3%
Burlington	N/A	N/A	9,640	11,094	-
Mt. Vernon	N/A	N/A	35,634	42,397	-
Mt. Vernon as a percent of Skagit Co.	-	-	45%	46%	

SOURCE: U.S. Department of Commerce, Census of Business, 1954, 1958, 1963, 1967

11. The impact of flooding on retail sales within the flood plain is a result of commercial losses due to flood damaged store furnishings; stocks of merchandise; building foundations; superstructures and improvements; damaged equipment; vehicles and grounds; and the interruption of normal business.

Transportation Services

12. Skagit County is served by all major forms of transportation. Two railroads, the Burlington Northern and the Chicago, Milwaukee, St. Paul and Pacific, provide access to the area. In addition, the county is readily accessible by vehicle from Seattle via Interstate Highway 5, which extends north-south. State Highway 20 runs from Anacortes on the west through the Skagit River Valley east to the Cascades and extends into Eastern Washington as the North Cascades Highway, which is closed

during winter months. Deep sea shipping terminal facilities serve the petroleum refineries at Anacortes, and ferry service from Anacortes is a major transportation link to the San Juan Islands and Victoria, B.C. There are no major scheduled commercial airlines serving the area, but local fields are operated for charter and regional airline service.

13. Mount Vernon is readily accessible by highway from all areas of the State as it is located at approximately the intersection of Interstate Highway 5 and State Highway 20 (North Cascades Highway).

Recreation

14. Skagit County has many tourist and recreational attractions due to the variations in its natural characteristics. Along with other counties in northwest Washington State, it shares the impressive Cascade Mountain range. Portions of the North Cascades National Park and the Glacier Peak Wilderness are located in eastern Skagit County, and the principal access is through the Skagit River Valley. The county's economic potential has yet to be realized, but the recent completion of the North Cascades Highway, which opened hitherto inaccessible natural attractions, should be a major stimulant to tourist and recreational activity in the county.

15. Geographically Skagit County serves as a good point of departure by ferry (from Anacortes) to the San Juan Islands thereby making the county important to vacationers. The islands of Skagit County, which include Fidalgo, Guemes, and Cypress, are a part of the San Juan archipelago. Fidalgo Island, connected by bridge to the mainland, has experienced considerable recreational development in the past decade with land and marina development at Skyline representing a major investment. For the most part, however, the potentials for Skagit County tourism and recreation have not been developed; given the rural character of this region and its impressive natural endowments, the opportunities for future development are considerable. The principal disadvantage which must be overcome is that Skagit County must compete with nearby areas which offer the tourist or recreational visitor similar attraction.

Other Services

16. The normal complement of community services such as hospitals, nursing homes, a community college, financial institutions, libraries, hotels, motels, schools, and churches are available in Skagit County. As with most other economic activities, the financial and service

centers for Skagit County are located in Mount Vernon. A community college, which draws students from all areas of the State, is located in Mount Vernon. In 1967, receipts from services totaled $6.5 million in Skagit County, $2.9 million (about 44 percent) of which were generated in the city of Mount Vernon. As shown in table B-3, sales of selected services in constant dollars increased at an average annual rate of 3.6 percent between 1954 and 1967 in Skagit County. During this same time period, sales of selected services for the State of Washington rose at an average annual constant dollar rate of 4.9 percent.

TABLE B-3

SELECTED SERVICES
WASHINGTON AND SKAGIT COUNTY 1954-1967

($1,000 - 1967)

	1954	1958	1963	1967	Average Annual Increase 1954-1967
Washington	$407,962	$504,534	$589,065	$766,956	4.9%
Skagit Co.	4,101	5,559	6,332	6,519	3.6%
Burlington	N/A	N/A	377	429	-
Mt. Vernon	N/A	N/A	2,619	2,877	-
Mt. Vernon as a percent of Skagit County	-	-	41%	44%	

SOURCE: U.S. Department of Commerce, Census of Business, 1954, 1958, 1963, 1967.

Human Resources

Population

17. The population of Skagit County totaled 52,381 in 1970. As shown in table B-4, the rate of population growth has been less than that for Washington State. The slower rate of population increase is probably the result of two factors - a declining rate of natural increase and net out-migration from the county. Net out-migration (the balance between migrants in and migrants out) was 2,271 between 1960 and 1970. The loss of population to other areas is probably due to the attraction of employment opportunities elsewhere, compared to those available in the fairly static agricultural and extractive resource base of Skagit County. Between 1940 and 1970, county population increased 1.1 percent on an annual basis, compared to an annual growth rate of 2.3 percent for the State of Washington for the same period. During this 30 year period, Mount Vernon and Burlington had the highest rates of increase of the incorporated cities within Skagit County, with average annual rates of 2.4 percent and 2.2 percent, respectively. Over the same period, Concrete lost 286 inhabitants for an average annual decrease of 1.4 percent. This loss was largely the result of a major cement manufacturing firm closing its local plant in 1969.

TABLE B-4

HISTORICAL POPULATION
WASHINGTON AND SKAGIT COUNTY

	1940	1950	1960	1970	Average Annual Percent Increase
Washington	1,736,200	2,379,000	2,853,200	3,409,300	2.3
Skagit County	37,650	43,270	51,350	52,380	1.1
Anacortes	5,880	6,920	8,410	7,700	0.9
Burlington	1,630	2,350	2,970	3,140	2.2
Concrete	860	760	840	570	(-1.4)
La Conner	620	590	640	640	0
Mount Vernon	4,280	5,230	7,920	8,800	2.4
Sedro-Woolley	2,950	3,300	3,700	4,600	1.5

SOURCE: U.S. Department of Commerce, Census of Population.

18. Of the total 1970 population for Skagit County, 24,240 (46.3 percent) lived in urban areas, while 28,140 (53.7 percent) lived in areas classified as rural. As shown in table B-5, the county is slowly being urbanized. The Skagit Regional Planning Council felt that this was due to the overall decrease in the rate of population growth.

TABLE B-5

SKAGIT COUNTY POPULATION DISTRIBUTION

	Urban		Rural	
1970	24,240	46.3%	28,140	53.7%
1960	23,010	44.8%	28,340	55.2%
1950	15,450	35.7%	27,820	64.3%

SOURCE: Skagit Regional Planning Council, Mt. Vernon, Washington, Comprehensive Land Use Planning Alternatives for the Skagit River Flood Plain and Related Uplands, April 1973.

19. In 1970, 98.1 percent of Skagit County's population was white. The nonwhite population of 1,011 was only a slight increase from the previous dacade with 650 being American Indians; 182 Mexican-American; 134 Oriental; and 45 black.

20. Average age has increased in the last decade (1960-1970), while the number of children under 5 years of age has decreased. This is attributable to the declining birth rate. Of the total county population, 35 percent are over 45 years of age, compared to only 29 percent of the State population. The recent decrease in the ratio of younger county residents to older may have contributed to the decrease in the rate of population growth for the county.

Employment and Unemployment

21. Employment within the county shows diverse trends in different industries. Agricultural employment has declined in line with national trends. Within manufacturing, employment in food processing and stone-clay-glass (reflecting closure of the cement plant at Concrete) has declined sharply; but employment in lumber and wood products has maintained its levels. There have been significant increases in employment in nonmanufacturing jobs, particularly in trade, government, and

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services. However, employment in Skagit County has grown only 6 percent over the past decade, in contrast to an increase of 26 percent statewide.

22. Total employment in Skagit County during 1970 averaged 19,700. The trends in employment in the principal industries of the county over the past decade are shown in table B-6. The basic activities in the county-agriculture and processing of agricultural products, forestry and lumber production, and in much smaller numbers fishing, mining, and petroleum refining - are reflected in the employment distribution. Also significant but not separately identified is the amount of employment generated by the recreational and tourist industry.

TABLE B-6

INDUSTRY EMPLOYMENT

	1960	1965	1970
Civilian labor force	20,750	21,150	22,430
Workers in labor-management disputes	0	0	0
Unemployment	2,250	1,620	2,730
Percent of labor force	10.8	7.7	12.2
Employment	18,500	19,530	19,700
Agricultural	3,340	3,440	3,120
Nonagricultural	15,160	16,090	16,580
Employer-own account, unpaid workers and domestics	3,060	3,160	2,910
Wage and salary workers	12,100	12,930	13,670
Total manufacturing	4,110	4,420	3,450
Food and kindred products	1,050	1,020	700
Lumber and wood products	1,240	1,390	1,270
Printing and publishing	80	70	70
Stone, clay and glass products	170	200	80
Misc. durable goods	NA	870	570
Misc. nondurable goods	NA	870	760
Forestry, fishing, mining and misc.	160	170	160
Contract construction	700	690	860
Transp. comm. utilities	690	710	690
Wholesale and retail trade	2,320	2,440	3,060
Finance, insurance and real estate	280	320	400
Services	1,210	1,110	1,460
Government	2,630	3,070	3,590
Educational services	980	1,110	1,330
All other government	1,650	1,960	2,260

SOURCE: Washington State Employment Security Department

23. Slow growth in Skagit County employment has produced a net out-migration of population. Despite this, the unemployment rates in Skagit County have been high throughout the decade (the best year was 1968 when the unemployment rate was as low as 7.4 percent). Contributing to high unemployment rates is the seasonal nature of the county's basic industries, but rates of unemployment in recent years (1973 average was 10.1 percent) reflect depressed market conditions as well as chronic tendency for population growth to outrun the creation of new jobs in this resource-extractive economy. In August of 1973, Northern State Hospital in Sedro Woolley was closed and thus eliminated employment of its average work force of 650. This contributed to a recent increase in the county unemployment rate to 13.1 percent 1/ in April of 1974.

Personal Income

24. Total personal income (an indicator of the magnitude of economic activity in an area) was $204.1 million in 1971 in Skagit County. This represented a 263 percent increase from the 1950 total of $56.3 million, an average annual increase of 3.6 percent when converted to constant dollars. The State of Washington experienced an increase of 259 percent during this same time period. In 1971 Skagit County contributed 1.4 percent of the total personal income in Washington State, and this percentage has remained constant since 1950. In 1971 per capita personal income for Skagit County was $3,859, almost double the $1,297 attained in 1950. The State registered a 149 percent increase in per capita personal income from 1950 to 1971. In 1971 per capita income in Skagit County was $310 below that for the State. Table B-7 shows total personal income and per capita personal income for the State and the county for the years 1950, 1965, 1970 and 1971.

1/Washington State Employment Security Department.

TABLE B-7

TOTAL PERSONAL AND PER CAPITA PERSONAL INCOME FOR
SKAGIT COUNTY - 1950, 1965, 1970 and 1971

	Total Personal Income (millions of current dollars)					Per Capita Personal Income (current dollars)				
	1950	1965	1970	1971	Percentage Change 1950-1971	1950	1965	1970	1971	Percentage Change 1950-1971
Washington	$3,995.0	$8,652.0	$13,730.0	$14,349.0	259 %	$1,674	$2,616	$4,022	$4,169	149 %
Skagit County	56.3	132.1	188.0	204.1	263 %	1,297	2,682	3,585	3,859	198 %
Skagit County as a percent of Wash.	1.4 %	1.5 %	1.4 %	1.4 %	-	77 %	103 %	89 %	93 %	-

Source: U.S. Department of Commerce, Computer listing of Total and Per Capita Personal Income for SMSA's and non-SMSA Counties of Washington; U.S. Department of Commerce, Survey of Current Business, August 1973.

Community Services and Facilities

Housing

25. The following summary of housing characteristics for Skagit County and the 100-year flood plain area is based on information presented in Comprehensive Land Use Planning Alternatives for the Skagit River Flood Plain and Related Uplands, Skagit Regional Planning Council, April 1973. Of the 19,575 dwelling units located in Skagit County in 1970, 17,185 (approximately 88 percent) were occupied. The average household size was 3.28 persons. Of the occupied units, 74 percent were owner-occupied and approximately 26 percent were rental occupied. The average value of the owner occupied units was $17,775. The average monthly rental was $76. Approximately 89 percent of the dwelling units were classified as sound; approximately 8 percent were classified as deteriorating; and approximately 3 percent were classified as dilapidated. There are 716 mobile homes used as dwelling units within the county. The Skagit Regional Planning Council predicted that within the next 20 years approximately 2,084 new dwelling units will have to be constructed in the county.

26. Within the floodplain, the single family dwelling unit is the primary residential structure. This trend is expected to continue unless altered by one or more of the following factors: (1) increased use of mobile homes as permanent residential structures; (2) expanded development of multifamily residential structures; and (3) the increased use of planned unit development versus conventional subdivisions. All future home construction within the 100-year flood plain will be subject to the flood proofing requirements of the Washington State Flood Plain Management Program. As land prices escalate, it can be assumed that there will be increased use of high density developments. However, the offsetting factor in the flood plain is the seeming abundance of vacant and potentially developable land, pending amount of flood proofing required. There will most likely be a slow continuation of the diversification of housing types within the flood plain. Demand for rural and ranchette as well as townhouses and garden apartments is expected to continue, especially near urbanized areas, lakes and shorelines within the flood plain.

27. Flooding adversely affects the quality and dollar value of housing available. Floodwaters rarely carry entire houses off their foundations; however, significant damage, such as shifting and settling of foundations, damp rot in timbers, buckling of floors and walls, shorting of electrical systems, rusting of tools and appliances, and the soiling of furniture, rugs, and draperies, often result from flooding. The homeowner must spend funds which might have otherwise gone for home improvements on costly flood damage repairs.

Police and Fire Protection

28. In areas threatened by a high probability of flooding, police and fire departments must answer to an increased demand for services under handicapped conditions. Rescue operations during a flood are hampered by inundated roads. Often times there is the threat of looting when people are forced to evacuate homes and businesses. Floods also promote fire by dislodging tanks and spreading oil and gasoline, by hampering the work of fire fighting units, by closing down water pumps, by damaging electrical and heating systems, and by disrupting sprinkler systems.

Water and Sewage

29. Essentially all water used for consumptive, agricultural, sewage disposal, and industrial purposes within the flood plain originates in watersheds located in Skagit County and Mount Baker National Forest. The Skagit River and its tributaries are the major source of water. The average daily flow of water on the Skagit River at Mount Vernon is approximately 9 billion gallons per day. Abundant water is located on or close to the ground surface, making it possible to deliver water throughout the flood plain through essentially undeveloped rights-of-way. This is done at nominal cost since neither extensive pumping nor lift stations are required. However, because the water supply is located near or on the ground surface, it is vulnerable to contamination during flooding.

30. According to the 1970 revised edition of the Overall Economic Development Plan for Skagit County, sewage facilities are desperately needed. Existing lines and treatment facilities are presently inadequate to handle the existing demands. City and county groups are currently trying to determine how to attract the industry required to build adequate sewage systems in this area of low population density and a relatively high tax structure.

Future Development

31. The overall pace of future growth in Skagit County should remain below that of the State of Washington. Per capita incomes are also expected to continue below the State average due to the seasonability

of the dominant industries in the county - agriculture, food processing, and lumber and wood products.

32. Agriculture should remain one of the controlling factors influencing economic activity, although its relative importance is expected to decline as economic expansion forces a transfer of land from agriculture to urban use and manufacturing and tourism expand their share of the economic base. Processing of fruits, vegetables, and fish products, most of which is tied to agriculture, should parallel changes in this sector.

33. Lumber and wood products manufacturing employment should remain relatively stable in the future. Output may expand, but technological changes are expected to continue to offset the need for expansion of employment. Future growth in the industry should result from local processing of a larger percentage of the timber harvested in the county, development of hardwood species, such as red alder for furniture, paneling and cabinets; and utilization of wastewood products such as bark.

34. Easier access to the major metropolitan centers of Puget Sound, combined with the crowding and the high price of land in these areas, has caused industry to examine possibilities of expansion to fringe areas such as Skagit County. This may result in establishment of additional nonresource oriented manufacturing such as machinery and fabricated metals.

35. Several metallic and nonmetallic mineral deposits are located in the county. Their future use is uncertain, however, because their quality and quantity is unknown. Now that the North Cascades Highway has been completed, there may be future exploration of the county's mineral resources.

36. Tourism and recreation are expected to rank among the most important future growth industries in Skagit County. The impact will come from people entering the county to visit North Cascades National Park; persons passing through the county traveling to and from the San Juan Islands and Canada; and from development of resorts, retirement homes, and vacation homes.

PROBLEMS AND NEEDS

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PROBLEMS AND NEEDS

1. This section discusses flood problems and damage reduction needs of the Skagit River basin. Storm characteristics, streamflows, hydrologic analysis, area subject to flooding, and historical damages are discussed in a general way as they relate to the entire basin and specifically as they pertain to that portion of the Skagit River flood plain below the mouth of the Baker River, which would be influenced by additional flood control storage at the Upper Baker project. Subsequent sections will provide further coverage.

Status of Existing Plans and Improvements

2. Farmland and towns in the delta flood plain west of Sedro Woolley are afforded low-level protection by locally constructed levees that prevent flooding from the river and in the lower estuary from tidal saltwater. About 43 miles of main stem river levees have been constructed which give some protection against spring and winter floods. Levees along the saltwater bays and channels prevent inundation by high tides. There are 16 diking districts (see plate C-1) which have inclosed a total of 45,000 acres of land within the levees, with individual owners having inclosed an additional 1,000 acres. Between Concrete and Sedro Woolley, low levees protect several rural areas and the town of Hamilton from minor floods.

3. The existing diking district levees vary in level of protection and will safely withstand riverflows from 84,000 to 130,000 c.f.s. Floods of these magnitudes can be expected to recur on the average of once every 3 to about once every 10 years, respectively. These flows are based on a minimum 2-foot levee freeboard allowance. New levees are required to have 3 feet of freeboard above the design flow for safety and to allow for settlement. However, as the existing levees have been in place many years, a settlement allowance of 1 foot is not needed. The existing levees were generally constructed from river sediments ranging from fine silty sand to fine sandy silt, which tend to be unstable when saturated.

4. Seattle City Light has constructed three hydroelectric power dams on the main Skagit River. Ross Dam (river mile 105) has a reservoir with usable storage capacity of 1,280,000 acre-feet. Since 1953, 120,000 acre-feet of Ross Reservoir space has been reserved for flood control from 1 December to 15 March. The installed generator capacity at Ross Dam is 360,000 kilowatts (kw). This project supplements low flows for the run-of-the-river plants and Diablo and Gorge Dams located downstream. Diablo Dam, at river mile 100, has a generator capacity of 122,000 kw; and Gorge Dam, at river mile 96, has a generator capacity of 134,000 kw.

5. Puget Power operates two hydroelectric power projects on the Baker River--Lower and Upper Baker Dams and Reservoirs located at river miles 1 and 9, respectively. Sixteen thousand (16,000) acre-feet of storage space at the Upper Baker project is available for flood control regulation to compensate for valley storage lost as a result of the project. Lower Baker project was completed in 1927 and has an installed capacity of 64,000 kw. The Upper Baker project was completed in 1959 and has a generator capacity of 94,000 kw.

6. Skagit River flood frequencies discussed in this report reflect a condition with full allowance for the Ross Dam flood control storage.

7. No Federal flood control works have been constructed in the Skagit River basin. The Flood Control Act of 1936 authorized the Avon Bypass a project for the partial control of floods in the lower Skagit Valley. The bypass channel, as proposed, would divert excess Skagit River flow from the main river channel near Burlington to Padilla Bay. The project has not been undertaken, as Skagit County has been unable to meet the requirements of local participation. Substantial costs would be involved in the relocation of transportation facilities and the acquisition of right-of-way. Also, the project would pass through an area used for agricultural purposes, resulting in significant disruptions. The most recent studies, conducted in 1966, indicate the Avon Bypass should have a capacity of 60,000 c.f.s., although it would be possible to construct the facility to handle larger flows.

8. The Flood Control Act of 1966 authorized construction of a levee and channel improvement project along the Skagit River from just upstream of Mount Vernon downstream along its north and south forks. Also authorized by the 1966 act was Federal cost-shaving of recreation facilites as part of the Avon Bypass project. The levee and channel improvement project would provide a uniform minimum safe channel capacity of 120,000 c.f.s. from just upstream of Burlington downstream through the delta. This capacity would allow safe passage of floods (under existing conditions of upstream storage) having an average recurrence interval of up to 8 years. In combination with the Avon Bypass, the levee and channel improvement project would provide protection against the floods having an average recurrence interval of up to 35 years. The latter project has been held up pending additional storage development or construction of the Avon Bypass.

9. Previously completed studies, which led to the authorization of the Skagit River Levee and Channel Improvement project, found that additional upstream flood control storage is necessary to achieve the high level of protection desired by Skagit County. The county has indicated a desire to have protection against a 50-year flood for agricultural areas, and possibly 100-year protection for the built-up or urban areas.

10. Only a few potential sites remain for upstream storage development in the Skagit River basin. The change of operation of the Upper Baker River project as recommended in this report could provide 58,000 acre-feet of the additional flood control storage. Other sites are located on the Cascade River, about 8 miles above its confluence with the Skagit River, and on the Copper Creek site, located on the main stem of the Skagit River at about river mile 87. These two sites, which have only minor flood control storage potential, were considered in the past by the city of Seattle for run-of-the-river power projects. Storage at the Faber site, located about 8 miles above Concrete on the Skagit River, also has been investigated in previous studies which found that the foundation and abutment conditions were not favorable. In addition, a main stem structure at this site would be a major obstruction to the passage of migratory fish.

11. Storage has been considered on the Sauk River as an alternative to the Faber site. A site, located approximately 5 miles above the river's mouth, appears to be the only remaining potential in the Skagit River basin at which major upstream storage is possible. A dam at this location could develop approximately 700,000 acre-feet of storage. Feasibility studies have not been conducted of the Sauk project pending the outcome of the current investigation by the U.S. Forest Service being conducted in response to the National Wild and Scenic Rivers Act (Public Law 95-42). The Skagit River and its tributaries, the Sauk, Suiattle, and Cascade Rivers, are being considered for possible inclusion in the National Wild and Scenic Rivers system. Feasibility studies of storage development on the Sauk River have been held in abeyance until the Forest Service study is completed.

12. A small hydroelectric power plant is operated by Seattle City Light on Newhalem Creek, which has a plant capacity of 2,000 kw. The plant was built in 1921.

Flood Problems

Climatology and Streamflow

13. Flood control storage at the Upper Baker project is effective in controlling Baker River discharges below the project and partially effective in regulating the Skagit River west of Concrete. Skagit River runoff depends on climatic conditions over the entire basin. Therefore, this section discusses the climate, temperature, precipitation, and snow information for drainage both above and below Concrete. Runoff into the river system was determined by investigating discharge records for the entire basin. Streamflow characteristics and flood descriptions are detailed only for Baker River and the lower Skagit River. Flood control using storage space in Upper Baker reservoir is described for Concrete, Sedro Woolley, and Mount Vernon. Results are illustrated as frequency curves which estimate the probability of regulating future floods based on information contained in the hydrologic records.

Watershed

14. The Skagit River basin is in the northwest corner of Washington State. Major Skagit River floods also affect Samish River basin adjacent to the northwest boundary of Skagit River basin. The two basins drain an area of 3,277 square miles between the crest of the Cascade Range and Puget Sound. The northern end of the Skagit Basin extends 28 miles into British Columbia, Canada. During major floods the Skagit River overflows the low divide at Sedro Woolley onto the Samish River flood plain. Flood problems of the two streams are related, and therefore, both streams are treated in the report as one large basin.

15. Ross, Diablo, and Gorge Dams lie in a canyon about 10 miles long. These dams control runoff from 37 percent of the entire basin. Within a distance of 20 miles the Skagit is joined by the Cascade, Sauk, and Baker Rivers, its three largest tributaries. The Cascade River joins the Skagit River from the south at the town of Marblemount and contributes 6 percent of the basin's runoff. The Sauk River, largest of the Skagit River tributaries, also enters the Skagit from the south contributing about 23 percent of the total basin runoff.

16. Baker River heads in Mount Baker National Forest, flows south 24 miles through Upper and Lower Baker Dams, and joins the Skagit River at the town of Concrete. Baker River drains an area of 298 square miles, which is 10 percent of the total Skagit River basin. The Skagit River drains an area of about 3,000 square miles and emerges upon its delta plain near the city of Sedro Woolley. At Sedro Woolley the river changes course to the southwest and flows along the southeastern and landward side of its delta. Finally, the river divides into typical delta distributaries and empties into Skagit Bay, draining a total area of 3,140 square miles. An additional 137 square miles is drained by the Samish River basin west of Sedro Woolley.

Climate

17. Runoff from the Skagit River basin depends on rainfall and snowmelt as produced by climatic conditions. Due to the proximity of the Pacific Ocean to the Skagit basin, the influence of maritime air masses is pronounced in both the temperature and precipitation regimes, producing a mild but wet climate. During the winter the Skagit basin, lying directly in the storm path of cyclonic disturbances from the Pacific, is subject to numerous storms, which are frequently quite severe and may follow one another in quick succession. On the mountain slopes, storm precipitation is heavy and almost continuous as a result of combined frontal and orographic effects. During summer months, the weather is warm and relatively dry as the Aleutian low pressure system is displaced by a semipermanent high pressure system.

Climatological Records

18. The U.S. Weather Bureau has maintained a total of 23 climatological stations in or near the basin, of which 17 are currently operating. Another climatological station, formerly maintained by the Department of Agriculture, Province of British Columbia, in the portion of the basin extending into Canada, has been inactive since 1955. The elevations of these stations vary from 14 feet at Mount Vernon to 4,150 feet at Mount Baker lodge, with 15 of the 24 stations below 1,000 feet and 5 above 3,000 feet. Three stations in the latter group were not activated until 1961. The locations of these stations, together with their periods of record, are shown on plate C-2. A summary of precipitation and temperature data for 11 representative stations will be found in table C-1.

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TABLE C-1

SUMMARY OF CLIMATOLOGICAL DATA

Station	Elev.	Period of Record 1/	Annual Precipitation (Inches) Mean	Greatest	Least	Snowfall (Inches) Mean Annual	Temperature (Deg. F) Mean Annual	Highest	Lowest
Anacortes	30		25.70	35.18	15.97	6.5	51.4	95	6
Baker Lake	670	1926-34	102.88	133.39	69.26	58.1	-	-	-
Concrete	270		65.21	82.94	39.18	33.5	51.6	102	0
Darrington R.S.	550		80.51	104.89	51.33	47.4	49.3	105	-14
Diablo Dam	891		71.56	94.72	45.86	71.9	48.5	106	-10
Marblemount R.S.	348	1941-61	77.23	99.59	50.36	-	-	-	-
Mt. Baker Lodge	4,150	1926-42 1946-60	109.85	141.97	74.13	515.9	40.1	91	-12
Mount Vernon	14	1956-64	32.01	38.69	24.09	5.2	50.3	98	-4
Newhalem	525		78.22	102.85	48.40	52.9	50.1	109	-6
Sedro Woolley	56		46.07	64.60	30.83	10.1	50.7	96	-2
Silverton	1,500	1942-61	112.61	151.27	77.03	88.0	46.7	103	0

1/Climatological normals based on standard record period 1931-60 unless otherwise noted.

Temperature

19. The mean annual temperature for stations in or near the basin varies from 40.1° F at Mount Baker lodge to 51.6° F at Concrete. Mean monthly temperatures vary from 26.9° F at Mount Baker lodge to 39.7° F at Anacortes in January, and from 56.7° F at Mount Baker lodge to 69.1° F at Mount Vernon in August. The temperature extremes recorded in the basin are 109° F at Newhalem and -14° F at the Darrington ranger station. Mean monthly temperature data for nine representative stations are presented in table C-2.

Precipitation

20. Precipitation over the basin normally varies greatly, with an annual range of approximately 150 inches. A normal annual amount of 40 inches or less falls in the vicinity of the mouth of the river and that portion of the basin in Canada which lies in a topographic rain shadow. A normal amount of 180 inches or more falls on the higher elevations of the Cascade Range in the southern end of the basin and over the higher slopes of Mount Baker. Normal annual precipitation at Baker Lake is 103 inches. Normal annual precipitation over the basin above the town of Mount Vernon is 92.2 inches, approximately 75 percent of this amount falling during the 6-month period October through March. The mean monthly precipitation at stations in or near the basin ranges from 0.87 inch in August at Anacortes to 16.99 inches in December at Mount Baker lodge. The maximum recorded precipitation for 1 month is 41.95 inches at Silverton in January 1953. Storm studies indicate that 5 to 6 inches of rainfall in 24 hours have occurred over much of the basin. Mean monthly precipitation data for nine representative stations are presented in table C-2.

Snow

22. Snowfall in the Skagit River basin is dependent upon elevation and proximity to the moisture supply of the ocean. The mean annual snowfall varies from 5.6 inches at Anacortes to 525 inches at Mount Baker lodge with an annual maximum of 699 inches recorded at the latter. Snow surveys have been made within the Skagit basin since 1943. In

TABLE C-2

NORMAL MONTHLY TEMPERATURE DATA

Station	TEMPERATURE (DEG. F) 1/												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Anacortes	39.7	42.1	45.3	50.6	55.5	59.4	62.4	62.1	58.7	52.7	45.5	42.5	51.4
Concrete	36.7	40.1	44.5	51.3	57.3	61.1	65.4	65.2	61.2	53.3	43.7	39.2	51.6
Darrington R.S.	35.0	37.9	41.8	48.8	54.9	59.1	63.5	63.0	58.5	50.6	40.7	37.0	49.3
Diablo Dam	31.7	35.3	40.0	47.1	54.7	59.0	65.0	64.4	59.5	49.7	39.5	35.1	48.5
Mt. Baker Lodge 2/	26.9	29.7	32.1	35.8	43.3	47.8	54.0	56.7	49.4	42.5	34.7	29.0	40.1
Newhalem	33.8	37.5	42.0	49.5	56.4	60.4	65.5	65.1	60.7	51.6	41.9	36.9	50.1
Sedro Woolley	38.0	41.0	44.7	50.1	55.4	59.3	62.5	62.3	58.4	51.8	44.0	40.4	50.7
Silverton 2/	33.0	36.0	41.0	45.4	51.6	57.0	61.2	60.2	54.8	47.2	39.6	33.4	46.7
Mount Vernon 2/	39.4	41.4	44.4	49.3	55.5	59.7	63.1	69.1	57.1	50.6	42.6	41.4	50.3

TABLE C-2 (Con)

Station	PRECIPITATION (Inches) 1/												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Anacortes	3.40	2.53	2.39	1.52	1.27	1.51	0.78	0.87	1.45	2.68	3.48	3.82	25.70
Baker Lake 2/	15.60	10.88	12.66	5.91	4.96	3.56	1.93	1.43	6.10	11.16	12.02	16.67	102.88
Concrete	8.80	7.03	6.76	4.12	2.87	2.75	1.30	1.50	3.57	7.03	9.10	10.38	65.21
Darrington R.S.	11.79	9.37	8.13	5.30	3.43	3.20	1.36	1.50	3.92	8.23	11.14	13.14	80.51
Diablo Dam	10.00	8.55	6.78	4.44	2.48	2.07	1.24	1.33	3.49	8.03	10.54	12.32	71.56
Marblemount R.S. 2/	10.98	9.19	7.06	5.17	3.20	3.05	1.57	2.21	4.33	8.61	10.25	11.61	77.23
Mt. Baker Lodge 2/	11.86	10.61	12.12	8.52	6.39	4.73	3.32	3.19	7.64	11.34	13.14	16.99	109.85
Newhalem	10.88	8.77	7.45	4.75	2.94	2.70	1.50	1.76	4.14	8.96	11.04	13.33	78.22
Sedro Woolley	5.57	4.33	4.65	3.30	2.56	2.78	1.33	1.38	3.01	4.91	5.87	6.38	46.07
Silverton 2/	15.40	12.69	10.73	7.39	5.59	4.59	1.99	2.94	6.79	12.82	15.85	15.83	112.61

1/Climatological normals based on standard record period 1931-60 unless otherwise noted.
2/Period of record as shown on Table 1, Summary of Climatological Data.

1958, a network of snow courses was established in the Baker River basin. The locations of these snow courses are shown on plate C-2. The maximum snow depth and water equivalent for each course are tabulated on this plate also.

Discharge Records

23. Streamflow in the Skagit River basin has been measured at various gaging stations throughout the basin. Stream gaging began in 1903 at stations near Hewhalem and Sedro Woolley. Since then, the U.S. Geological Survey has operated and published records for 72 gages, including lake and reservoir stations, of which 24 are currently operating. Discharge records at the gaging stations on the Baker River at Concrete and below Anderson Creek near Concrete, and on the Skagit River near Concrete, near Sedro Wooley, and near Mount Vernon are used to describe streamflow characteristics for this study. Peak discharges at the three Skagit River sites have been subject to some degree of regulation since completion of Lower Baker dam in 1927. Other dams have been constructed since then, making necessary adjustments in the reported annual peak discharges to allow for changes of storage and travel time from appropriate storage projects for purposes of estimating natural peak discharges since 1927. Streamflow records at the Baker River gaging station below Anderson Creek near Concrete were continued at Upper Baker dam after construction of the dam in 1959 inundated the gaging station. Records at this station provide information on the magnitude of Baker River flows near Upper Baker dam during flooding on the Skagit River near Concrete.

24. Runoff per unit of area from the Baker River is somewhat higher than anywhere else in the basin. Baker River, which receives the effect of the initial lifting of Pacific air over the Cascade Range, has an annual runoff of 120 inches at Concrete. The Skagit River above Newhalem is in the rain shadow of these same mountains and has an annual runoff of 50 inches. The runoff for the entire basin is about 71 inches per year. Extremes in annual runoff at Mount Vernon have varied from 15,520,000 to 7,628,000 acre-feet, or 94.1 inches and 46.2 inches over the basin, respectively. The locations and pertinent data for these stations are shown on plate C-3. A summary of streamflow data for the key stream gages is shown on table C-3.

Streamflow Characteristics

25. The Skagit River basin is subject to winter rain floods and an annual high water due to snowmelt runoff. The annual snowmelt high

water usually occurs during the spring or early summer, caused by the seasonal rise in temperatures, with resultant melting of the accumulated snowpack. These high discharges may have a minor contribution from warm rains but are caused predominantly by snowmelt. The spring snowmelt is characterized by a relatively slow rise and long duration. Snowmelt discharges usually reach their highest mean monthly values in June. The resulting runoff occasionally inundates the lowest areas adjacent to the river but rarely reaches a damaging stage. The maximum recorded snowmelt discharge at Mount Vernon was 72,000 c.f.s. in 1967. It is during this annual spring or early summer high water that power reservoirs are filling; and as a result, the spring peak discharges are frequently reduced. The Skagit River and all of the major tributaries usually have low flows during August and September after the snowpack has melted and the ground-water flow has been partially depleted. The minimum recorded discharge at Mount Vernon was 2,740 c.f.s. in 1942.

26. With the advent of heavy precipitation in the fall and winter the rivers experience a temporary flow increase. Rain-type floods occur usually in November or December but may occur as early as October or as late as February. Antecedent precipitation serves to build up ground-water reserves and saturate the ground. Frequently, a light snowpack is then formed over most of, or the entire basin. A heavy rainfall, accompanied by warm winds, completes the sequence which produces major floods. The heavy rainfall and accompanying snowmelt result in a high rate of runoff as the ground is already nearly saturated from earlier precipitation. The maximum recorded discharge at Mount Vernon was 144,000 c.f.s. in 1951. Streamflow characteristics can be observed for Baker River and lower Skagit River gaging stations on plates C-4 through C-15 , which show daily discharge hydrographs together with annual maximum instantaneous discharges.

Flood Characteristics

27. The magnitude and intensity of a storm cannot always be used as an index of the resultant river discharge. Other factors, such as temperature sequence, degree of soil saturation, and moisture content of the snowpack, largely influence the rate and total amount of runoff produced by a particular storm. Conditions preceding a storm may be such that even a moderate storm could set in motion the related factors that, collectively, result in a flood. Conversely,

TABLE C-3

SUMMARY OF STREAMFLOW DATA
(THROUGH WATER YEAR 1960)

Stream	Station Location	Drainage Area in Square Miles	Period of Record	Annual runoff (cubic feet per second) Mean	52-year Normal	Annual Max.	Annual Min.	Extreme discharge in (cubic feet per second) Instant Max.	Daily Max.	Daily Min.
Skagit River	At Newhalem	1,175	1908-14, 1920-	4,339	4,555	6,300	2,650	63,500	42,400	136
Skagit River	Near Concrete	2,737	1924-	14,806	15,080	19,740	9,629	154,000	129,000	2,610
Skagit River	Near Sedro Woolley	3,015	1908-1924-	16,200	16,150	19,600	10,700	220,000	176,000	2,830
Skagit River	Near Mount Vernon	3,093	1940-	16,332	Miss.	21,440	10,510	144,000	138,000	2,740
Sauk River	Near Sauk	714	1910-12, 1928-	4,304	4,655	5,950	2,887	82,400	55,800	572
Baker River	Below Anderson Cr. near Concrete	210	1910-25, 1928-31	2,011	2,073	2,600	1,540	36,800	27,400	219

MEAN MONTHLY STREAMFLOW DATA (IN CUBIC FEET PER SECOND THROUGH WATER YEAR 1960)

Stream	Station Location	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Annual
Skagit River	At Newhalem	2,665	3,049	2,973	2,285	2,135	2,133	4,502	9,656	10,996	6,878	3,462	2,339	4,339
Skagit River	Near Concrete	11,627	13,769	14,860	12,653	11,779	10,700	14,660	23,597	26,383	19,054	10,177	8,303	14,806
Skagit River	Near Sedro Woolley	10,700	16,400	16,300	13,500	12,000	10,300	13,900	23,900	31,600	23,200	12,200	9,160	16,200
Skagit River	Near Mount Vernon	13,818	16,587	17,653	14,637	14,676	11,974	15,130	23,484	26,160	20,882	11,138	9,482	16,332
Sauk River	Near Sauk	3,071	4,151	4,500	3,678	3,443	3,092	4,255	6,933	7,976	5,669	2,723	2,104	4,304
Baker River	Below Anderson Cr. near Concrete	1,916	1,788	1,870	1,527	1,430	1,093	1,747	2,915	3,579	2,949	1,747	1,540	2,011
Baker River	At Concrete	2,433	2,835	2,498	2,065	1,986	1,566	2,308	3,937	4,441	2,422	1,998	1,763	2,619

conditions in the drainage basin may be such that a severe storm results in only minor high water. When storms are sufficiently general to affect the entire basin, the larger tributaries reach flood stage at much the same time and the resulting floods on the main river cause major damage to downstream areas.

28. Winter flows on the Skagit River are characterized by frequent sharp river rises resulting from concentrated 2- to 5-day storms or series of storms. All major floods of record have occurred during the period November through February and have been caused by high rates of precipitation with accompanying snowmelt. This type of flood has a crest which is normally higher and of shorter duration than the annual spring snowmelt high water. Discharges in excess of the channel capacity spread out across the valley above the delta and remain until the river drops. When a peak is of short duration, the discharge in the delta area can be much reduced by valley storage, as occurred in 1949. This results in a lesser discharge at Mount Vernon than upstream. However, if the near-peak flow continues for an extended period, the discharge can be greater at Mount Vernon than at upstream points because of downstream inflows and the reduced effectiveness of valley storage.

29. Since 1920, flood sizes have been reduced to varying degrees by incidental control at the power reservoirs. However, the locations of these reservoirs limit their flood control potential because of the contribution from large uncontrolled tributary areas downstream. Some reduction in flood peaks occurs naturally because of valley storage. The Nookachamps Creek area, on the left bank between Mount Vernon and Sedro Woolley, is a major source of natural valley storage during floodflows. Storage in this area can reduce major flows from 15,000 to 25,000 c.f.s. downstream from Sedro Woolley.

Flood History

30. Flood peak discharges have been compiled from published data for various locations in the basin. Table C-4 summarizes available data for three gaging stations relating to major and minor floods of record and the known historical floods. The figures for the six historical floods from 1815 to 1908 (listed in table C-4) were obtained from detailed studies by the U.S. Geological Survey, published as Water Supply Paper No. 1527, "Floods in the Skagit River Basin." The studies include information collected in 1923 by Mr. J. E. Stewart of the U.S. Geological Survey. After careful study and analysis of all data available to him, Mr. Stewart reached the conclusion that two great floods occurred prior to the arrival of settlers. The earlier and greater of these two floods probably was as large or nearly as large as the greatest flood that has occurred here within the last several hundred years.

These floods are estimated to have occurred about 1815 and 1856. Data for the floods of February 1932, January 1935, November 1949, and February 1951 should not be compared with the earlier floods because discharges of these later floods were modified by storage in upstream reservoirs. Following are descriptions of some of the historical floods experienced since systematic hydrologic record-keeping began on the Skagit River.

November 1909

31. The month of November 1909 was one of above average precipitation, but the snowfall was far below average. Although measurable precipitation fell over the basin an average of 24 days during the month, approximately 60 percent of the monthly total fell in the latter half of the month, as a series of Pacific storms moved through the region. The last and severest storm of the series moved into the region on the 26th of November, causing copious amounts of precipitation on the 28th and 29th. This latter storm, which lasted 66 hours, resulted in the greatest flood of record in the Skagit River. Total storm precipitation was 9.2 inches at Goat Lake; 8.3 inches at Skagit power plant; 5.9 inches at Concrete; and 2.5 inches at Sedro Woolley. The maximum 24-hour amounts were 5.6 inches; 5.8 inches; 3.8 inches; and 1.3 inches at these respective stations. The temperature and precipitation records at Goat Lake indicated that the percipitation fell mostly as snow above 2,500 feet on the 26th and 27th of November and mixed snow and rain on the 28th. However, on the 29th, the precipitation fell as rain up to elevations of 6,000 feet and, along with strong Chinook winds, melted off all snow to approximately 4,000 feet.

32. The resulting flood discharge - 260,000 c.f.s. at Concrete and 220,000 c.f.s. at Sedro Woolley - had the highest magnitude of any flood since the inception of records. The flood breached the dike near Burlington, flooding most of the land between Burlington and the Swinomish Channel. The Burlington dike is subject to overtopping and failure when flood discharges exceed 150,000 c.f.s. When this dike is overtopped or fails, floodwaters overflow the low divide which separates the Samish and Skagit basins. The floodwaters flow out through the Samish River basin and bypass Mount Vernon.

TABLE C-4

RECORD FLOOD DISCHARGES, SKAGIT RIVER
(Published Data)

Station	Skagit River near Concrete		Skagit River near Sedro Woolley		Skagit River near Mount Vernon	
Drainage Area	2,737 sq. mi.		3,015 sq. mi.		3,093 sq. mi.	
	Crest Discharge		Crest Discharge		Crest Discharge	
Date	cfs	cfs/sq mi	cfs	cfs/sq mi	cfs	cfs/sq mi
1815	500,000 1/	182	400,000 1/	135		
1856	350,000 1/	128	300,000 1/	101		
16 Nov 1896			185,000 1/	62		
18-19 Nov 1897	275,000 1/	100	190,000 1/	64		
16 Nov 1906			180,000 1/	60	180,000 1/	58
18 Nov 1908			97,000	33		
29-30 Nov 1909	260,000 1/	95	220,000	74		
21 Nov 1910			114,000	38		
29-30 Dec 1917	220,000 1/	81	195,000	66		
12-31 Dec 1921	240,000 1/	88	210,000	71		
27 Feb 1932	147,000	54				
13 Nov 1932	116,000	42				
22 Dec 1933	101,000	37				
25 Jan 1935	131,000	48				
27 Nov 1949	154,000	56	140,000 2/	47	114,000 3/	37
10 Feb 1951	139,000	51	150,000 2/	51	144,000	47
3 Nov 1955 4/	106,000	39	113,000 2/	38	107,000	35
23 Nov 1959 4/	89,300				91,600	30

1/Calculated by U.S. Geological Survey.

2/Estimated by Corps of Engineers.

3/Mount Vernon gage installed October 1940.

4/Include effect of 120,000 acre-feet of flood storage established at Ross Dam in 1953.

December 1921

33. Precipitation during the month of December 1921 was considerably less than the average for the previous 30 years in the Skagit basin. However, snowfall during the preceding month had been at near record levels; and much of this exceptional snowpack was still on the ground on the 10th of December, when a very intense rainstorm accompanied by strong Chinook winds moved into the Skagit basin. The storm, which lasted from 6 a.m. on the 9th till 12 p.m. on the 12th, produced rainfall which amounted to over 80 percent of the entire month's precipitation. The runoff produced the flood peak on December 13th, the second highest flood of record in the Skagit Valley. Observers reported that almost all of the snow was melted off the Cascades by the end of the storm. Rainfall during this storm period amounted to 14.2 inches at Silverton; 10.2 inches at Davis Ranch; and 3.4 inches at Sedro Woolley. Maximum 24-hour amounts were 5.9 inches; 5.0 inches; and 2.0 inches, respectively, at these stations.

34. The flood crested at 240,000 c.f.s. near Concrete but dropped to 210,000 c.f.s. at Sedro Woolley and 150,000 c.f.s. at Mount Vernon. A break in the dikes just above the Great Northern Railway bridge between Mount Vernon and Burlington allowed 60,000 c.f.s. to overflow into the Samish River Delta and the area between Bayview and Pleasant Ridges, but the remaining 150,000 c.f.s. was carried by the river channel. The decrease in discharge from Sedro Woolley to just above Burlington was caused by the storage of floodwaters in the river channel and in flooded areas.

February 1951

35. Weather conditions preceding the flood of February 1951 were typical of western Washington for this time of year. Periods of moderate to heavy rain occurred on 2 and 3 February as a low pressure system passed over the region. Soil saturation was maintained by light rain which continued through the 6th. A record low pressure system entered the area on the 7th, and the accompanying flow of warm, moist air produced excessive precipitation from the 9th through the 11th. The freezing level during this period was about 10,000 feet. Precipitation subsided by the 12th, following the arrival of colder air from Canada. The heaviest precipitation occurred on the 9th, with 24-hour amounts of 6.39 inches at Silverton, 6.21 inches at Diablo Dam, and 1.83 inches at Sedro Woolley.

36. This flood had a peak discharge of 139,000 c.f.s. at Concrete; a recorded peak of 150,000 c.f.s. at Sedro Woolley; and a peak of 144,000 c.f.s. at Mount Vernon. Upstream storage reduced the peak discharge at the gage near Concrete by about 13,000 c.f.s. However, as the peak had quite a long duration and a large amount of inflow occurred between Concrete and Mount Vernon, channel storage had little effect on reducing the peak stage in the lower reaches. The flood remained near its peak for 6 hours at Mount Vernon. The duration of this peak was more significant than its magnitude, because it minimized the effectiveness of natural storage in the Nookachamps Creek area, and dikes failed because they lacked sufficient cross-sectional dimensions to withstand a long period of high water.

December 1933

37. In contrast to the storms described above, the storms of December 1933 did not produce a flood of damaging magnitude on the Skagit River, although many other rivers in western Washington had floods of record or near record proportions. The month of December 1933 was one of unprecedented rainfall over western Washington. Practically every reporting station received more than twice its average amount for the month, while many stations reported three to four times their averages for the month. Measurable precipitation was recorded on 28 days of the month. Snowfall during the month was much heavier than normal; but the amount of snow remaining on the ground by month's end, though very wet and densely packed, was far below the average for the end of December. The precipitation was unusually heavy during a number of periods during the month, but the period from the 17th through the 22nd was the severest. Precipitation in the Skagit basin during this period varied from 2.5 inches at Anacortes to 11.41 inches at Darrington. It is estimated that nearly 25 inches fell over the higher elevations in the basin. The maximum 24-hour precipitation for the month was 1.15 inches at Anacortes and 3.55 inches at Darrington.

38. While precipitation was much higher than normal for December 1933, none of the individual 2- to 5-day storms produced severe flooding in the basin. Station precipitation records indicate that 24-hour amounts were less than for the November 1909 and December 1921 storms. Much of the precipitation occurred as snow at the mountain stations. This reduced direct runoff and also served to retard runoff from precipitation occurring as rain. These factors combined to produce high but nondamaging discharges throughout the basin.

November 1949

39. The flood of November 1949 is a good example of a flood crest flattening while moving downstream. Channel storage had a marked effect on the sharpness of the peak between Concrete and Mount Vernon. The peak discharge of 154,000 c.f.s. near Concrete was reduced to 114,000 c.f.s. near Mount Vernon. Precipitation records in the basin at the time of this flood partly explain the reduction in crest in the lower reaches of the channel. The Sedro Woolley gage indicated that very little rain fell in the lower part of the basin. In contrast, the flood of February 1951 had a flood crest of long duration. The peak near Concrete lasted many hours longer than the peak of November 1949, although it did not have as great a discharge. The peak of the November 1949 flood had remained above 120,000 c.f.s. for 14 hours, whereas the peak of the February 1951 flood remained above the same point for 22 hours. The duration of the peak reduced the effect of channel storage and the peak downstream was increased by a large contribution of runoff from the lower elevations. The peak discharge near Concrete was 139,000 c.f.s. increasing to 150,000 c.f.s. near Sedro Woolley.

Flood Frequency and Regulation

40. The basic Skagit River peak discharge frequency curves for the unregulated condition and for regulation by Ross Dam are from an earlier Skagit River study, "Skagit River - Flood Control and Other Improvements - March 1965." The curves are shown along with other regulated conditions on plates C-16, -17, and -18. Effects of two flood control projects have been added to the Mount Vernon frequency curve: (1) Avon Bypass and (2) Skagit River Levee and Channel Improvement (see page C-2). Updating the unregulated Skagit River frequency curves was not considered necessary to evaluation of potential storage on the Baker River.

Skagit River Reservoir

41. Flood magnitudes since 1927 have been slightly reduced by upstream reservoir storage. Storage characteristics of the five major Skagit River basin projects are tabulated in table C-5. Ross Dam

controls about 30 percent of the basin's runoff and is the only project that provides storage for flood control along the lower river. Prior to 1953, flood regulation was a byproduct of power storage. Since the installation of the spillway gates at Ross Dam in 1953, 120,000 acre-feet of storage, during the period 1 December to 15 March each year, has been reserved for flood control in accordance with the project license issued by the Federal Power Commission. Coordination is maintained between the city of Seattle and the Corps of Engineers to assure maximum benefits from this storage. Adequate control of the river downstream of Ross Dam is obtained by this allotted 120,000 acre-feet, and no appreciable reduction in downstream flood stages could be accomplished by additional storage at this location. The effect of Ross Dam during severe flooding is to reduce the 100-year flood at Concrete from 313,000 to 265,000 c.f.s. All flood profiles and other water surface elevations described in this report include full allowance for the 120,000 acre-feet of flood storage in Ross Reservoir. Seattle City Light plans ultimately to raise Ross Dam another 125 feet, but construction is not definitely scheduled. This would increase the reservoir capacity to 3,450,000 acre-feet but would not change the flood control allocation.

Table C-5

STORAGE CHARACTERISTICS OF EXISTING RESERVOIRS

Reservoir	Flood Control Storage	Maximum Storage	Maximum Usable Storage *
	Acre-feet	Acre-feet	Acre-feet
Ross	120,000	1,405,300	1,022,800
Diablo	-	90,140	76,220
Gorge	-	8,485	6,700
Upper Baker (Baker Lake)	16,000	285,470	220,630
Lower Baker (Lake Shannon)	-	Unknown	142,600

*Above minimum pool for power production.

Baker River Reservoir

42. Storage characteristics of Puget Power's Baker River projects are shown in table C-5. The Lower Baker project was completed in 1927 and the Upper Baker project in 1959. Flood storage capacity of 16,000 acre-feet is provided at Upper Baker project (Baker Lake) to compensate for natural channel storage lost by project construction.

Incidental flood storage results when Upper and Lower Baker reservoirs have been drawn down for power production. Reservoir drawdowns generally are more pronounced after 1 January than in the critical winter flood months of November and December.

43. Additional flood control storage at the Upper Baker project would help protect developments lying in the lower Skagit River flood plain. The Federal Power Commission license for the Upper Baker project states in Article 32: "The Licensee shall so operate the Upper Baker River reservoir as to provide each year 16,000 acre-feet of space for flood regulation between November 1 and March 1 as replacement for the valley storage eliminated by the development. Utilization of this storage space shall be as directed by the District Engineer, Corps of Engineers. In addition to the above-specified 16,000 acre-feet, the Licensee shall provide in the Upper Baker River reservoir space for flood control during the storage drawdown season (about September to April 15) up to a maximum of 84,000 acre-feet as may be requested by the District Engineer, provided that suitable arrangements shall have been made to compensate the Licensee for the reservation of flood control space other than the 16,000 acre-feet specified herein."

Historical Damages

44. The Skagit River has flooded many times in the past. However, the most recent flood causing extensive damage occurred in February 1951. Heavy damage was done to crops, land, buildings, roads, railroads, and other improvements. Some of the larger historical floods and the damages which would be caused by their recurrence under 1973 prices and conditions are presented in table C-6.

Table C-6

Historical Skagit River Floods

Date	Discharge 1/ (c.f.s.)	Damages 2/ ($)
1815	400,000	-
1856	300,000	-
Nov 16, 1896	185,000	22,500,000
Nov 19, 1897	190,000	22,800,000
Nov 16, 1906	180,000	20,350,000
Nov 30, 1909	220,000	29,500,000
Dec 30, 1917	195,000	23,850,000
Dec 13, 1921	210,000	27,050,000
Feb 11, 1951	150,000	18,630,000

1/Observed discharges near Sedro Woolley, Washington.

2/Estimated damages based on 1973 regulated discharge conditions.

45. Future floods, based on 1974 prices and conditions of development in the Skagit Valley, are expected to result in damages which would average about $4,246,000 annually.

Table C-7

AVERAGE ANNUAL FLOOD DAMAGES
(1974 Prices and Conditions)

Category	Damages
Agricultural	$1,843,000
Commercial	1,157,000
Residential	1,027,000
Other - rural	91,000
Other - urban	86,000
Emergency aid	42,000
Total	$4,246,000

Other Needs

46. Other water and related land resource needs and problems do exist in the Skagit River basin. These have been previously identified in the Puget Sound and Adjacent Waters Comprehensive Study and are discussed in a summary report and 15 supporting appendixes.[1/] The recommended operation change at the Upper Baker project in the interest of additional flood control is specifically a single-purpose proposal provided for by the Federal Power Commission license which authorized the project. Studies leading to this report have been limited to an evaluation of the feasibility of providing additional flood control storage space at the project, within the provisions of the Federal Power Commission license, and the determination of the effects and impacts on other resources uses, such as hydroelectric power generation and fish and wildlife production. Investigation of other basin water resource needs was beyond the scope of the authorized study.

1/Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters, State of Washington, Puget Sound Task Force Pacific Northwest River Basins Commission, 1971.

Improvements Desired

47. Public meetings were held on 25 April 1973 in Burlington, Washington and on 8 April 1975 in Mount Vernon, Washington. Federal, State, county, and local and private interests were in attendance at both public meetings. A number of informal meetings were held with Federal, State, county, and local and private interests during the period between the two public meetings.

48. In 1970, Skagit County adopted a comprehensive flood control plan when they formed a countywide flood control district in accordance with the laws of the State of Washington. The flood control district enables the county to assume the responsibility of sponsorship of various flood control improvement projects. Obtaining flood control storage from the existing Upper Baker project is currently viewed as phase one of the county's comprehensive flood control plan. Phase two of the plan provides for construction of the levee and channel improvement project authorized by the Flood Control Act of 1966. Phase three would be additional flood control storage on the Sauk River and/or construction of the Avon Bypass. The county has consistently, at the public meetings and in recent correspondence to the State of Washington's congressional delegation reaffirmed its desire for flood control improvements, particularly additional storage at the Upper Baker project. Skagit County has asked that the previously authorized Skagit River Levee and Channel Improvement project also be undertaken as soon as possible.

49. All those attending the final public meeting, who expressed their views, indicated agreement with the recommended plan. Skagit County Commissioners, in letter read at the meeting (see appendix 2) stated they would meet the local requirements called for in this report. Because the plan does not involve the construction of new facilities but merely calls for changing the operation of an existing project, without significant environmental impacts, no opposition has been voiced by environmental groups or fish and wildlife agencies. However, some concern was expressed by the former over possible flood plain development resulting from the increased flood protection provided by the plan.

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FORMULATING A PLAN

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SECTION D

FORMULATING A PLAN

1. Because the Skagit River basin has a potential for significant flood damages and serious disruption of its social-economic environment, flood control improvements are of utmost importance. While other water resource needs exist within the basin and have been identified through the Puget Sound and Adjacent Waters Comprehensive Study, this report is limited to flood damage reduction and, specifically, the question of whether or not additional flood control storage should be provided at this time at the Upper Baker project. Given this objective, this study was limited to an examination of three conceptual alternatives. Alternative 1 involved doing nothing to resolve existing and future flood damage problems; alternative 2 would rely only on the existing flood control works, including upstream storage plus flood plain management by Skagit County and the State of Washington; alternative 3 combined additional storage at the Upper Baker project with flood plain management. Under alternative 3 various volumes of storage and two possible operating schemes were considered.

2. The U.S. Fish and Wildlife Service and National Marine Fisheries Service have expressed a desire for having the flood control drawdown occur earlier than necessary for flood control purposes, in order to reduce the potential for sockeye salmon spawning along the higher elevations of the lakeshore when the Upper Baker project spawning channels are filled to capacity. When sockeye spawn at the higher elevations and the reservoir is later drawn down for hydroelectric power generation, the eggs are exposed to the atmosphere. As the purpose of the earlier drawdown would be to increase sockeye production over existing levels, it would have to be justified by fishery enhancement benefits. Some future investigation by the appropriate State and Federal fish and wildlife agencies should be undertaken to evaluate the justification of the fishery enhancement proposal. Any further change in project operation would require approval by the Federal Power Commission. No provision currently exists in the license for operating the project for fishery enhancement purposes.

Basis of Formulation and Evaluation Criteria

3. The formulation and evaluation of alternatives was done in compliance with the U.S. Water Resources Council's: "Principles and Standards for Planning Water and Related Land Resources" and Senate Document No. 97, 87th Congress, 2nd Session. Hydrologic and hydraulic data were obtained through Corps investigations, as well as information received from other Federal and State agencies. Socio-economic data used in evaluating the benefits and costs of the various alternatives considered were also derived by the Corps and obtained from other sources. The Federal Power Commission provided the power values used in evaluating power losses. Federal and State agencies having expertise in the fields of fish and wildlife management were relied upon to assist the Corps in its evaluation of the environmental impacts that additional upstream storage at the Baker River project could have on natural resources.

Technical Criteria

4. The following important technical criteria were adopted for use in developing a recommended plan.

a. Minimum safe Skagit River channel capacity in the leveed areas downstream from Burlington is 84,000 c.f.s., based on a freeboard allowance of 2 feet.

b. Upper Baker project would be regulated for flood control when the Skagit River discharge near Concrete is forecast to reach 90,000 c.f.s. (84,000 c.f.s. discharge at Mount Vernon).

c. When operating Upper Baker project for flood control, the Baker River discharges into the Skagit River at Concrete would not be reduced below the 5,000 c.f.s. power generation capacity of the Upper Baker project.

d. Baker River discharges following flood regulation would be increased by releases from the Upper Baker project until full flood control storage space is regained with the project regulated during this time to avoid raising the Skagit River discharge above the peak experienced initially.

e. The Ross Dam project would continue to be operated for flood control during the period 1 December to 15 March of each year with 120,000 acre-feet of storage reserved for flood control in accordance with the project license issued by the Federal Power Commission.

Economic Criteria

5. General economic criteria utilized are summarized as follows:

a. Tangible benefits must exceed project economic costs.

b. Scope of the development is such to provide the maximum net benefits, however, intangible considerations, such as risk to lives and property, could result in a project size which is greater than that which would produce maximum net benefits.

c. There are no more economical means, evaluated on a comparable basis, for accomplishing the same purpose or purposes which could be precluded from development if the recommended plan were undertaken. This limitation refers only to those alternative possibilities that would be physically displaced or economically precluded from development if the recommended plan were implemented.

6. The economic benefits were initially evaluated based on 1973 prices and conditions of development within the Skagit River flood plain, projected over a 100-year period of economic analysis. Following agency review of the draft authorization report benefits were updated to 1974 prices and conditions. An interest rate of 5-7/8 percent was used to discount future benefits. The average annual costs were taken as the cost of obtaining replacement power from combined public-private financed projects at an interest rate of 10 percent for private and 7-1/4 percent for public (non-Federal) financing (Federal Power Commission power values based on July 1974 price levels were used). The costs were derived for alternative power production (energy and capacity) to meet power losses computed for four cases of flood control reservoir operation rule curves. Case I represented the existing condition of 16,000 acre-feet provided as replacement for lost valley storage. Cases II, III, and IV represented 66,000; 100,000; and 74,000 acre-feet of total storage, respectively. Power losses used to compute economic costs were taken as the differences between Case I and Cases II, III, and IV. The power loss costs used in the economic evaluation of the proposed project operation change are substantially greater than the actual cost of providing replacement power to Puget Power, which would be the power revenues foregone based on the Bonneville Power Administration power rate schedule in effect during each year's operation. Annual costs also include the administration of additional flood control

regulation at Upper Baker project with provision for a five-year follow-up monitoring of environmental impacts that could occur as a result of the change in project operation.

Environmental and Other Criteria

7. The following environmental criteria and intangibles were employed in formulating the recommended plan:

a. Impacts of alternatives be carefully evaluated using an interdisciplinary approach utilizing fishery biologists, geographers, civil engineers, and other disciplines.

b. Fishery enhancement, except as incidental to flood damage reduction objectives, is beyond the scope of authorized studies.

c. All of the basic steps that are required in the preparation of an impact statement consistent with the National Environmental Policy Act of 1969 be followed.

d. Detrimental environmental effects are to be avoided where possible and feasible mitigating features considered when such effects cannot be avoided.

e. Public health, safety, and social well-being, including the possible loss of life, are to be carefully considered.

Possible Solution

8. Three possible courses of action were evaluated as described in the public brochure (appendix 3) in the process of arriving at a recommended plan that best satisfied the planning objectives in a way which would have minimal adverse impacts. The alternatives were: Do nothing, flood plain management alone, and flood plain management with additional flood control storage at Upper Baker project. The following paragraphs describe the alternatives and summarize their contributions to the planning objectives.

Alternative 1 - Do Nothing. This involves relying only on existing flood control facilities, including levees and upstream storage at Ross project for flood protection with no effort made to stem the growth of future flood damages through management practices. As Skagit County and the State of Washington through

the Department of Ecology have already established an effective flood plain management program, implementation of alternative 1 would be a step backwards. Assuming this were done average annual flood damages would be expected to grow from $4,246,000 in 1974 to $9,128,000 by the year 2027. Those costs would be borne by local residents in terms of flood damages, and by Federal and local governments in flood fighting and protection works repairs. This plan could encourage deterioration of the flood plain environment. Disruption of public services and potential hazard to life, health and safety would continue unmitigated. Consequently the plan would not meet the planning objectives.

10. Alternative 2 - Flood Plain Management Alone. Under alternative 2 reliance would remain on existing flood control facilities; but in addition, management measures including land use zoning, development restrictions, early flood warning, etc. would be employed to reduce the flood damage growth potential in the Skagit basin. Flood insurance, while made possible by proper local implementation of land use management practices in flood hazard areas, will not reduce damages but merely provide a means of compensation to the affected property owner. The availability, however, of Federally subsidized flood insurance acts as an inducement for flood plain management. Flood proofing of new buildings also is part of alternative 2. Existing buildings generally do not lend themselves to this measure because costs are usually prohibitive. In addition some buildings cannot be flood proofed effectively and public utilities and personal property, such as automobiles, gardens, yards and furnishings, etc. would still be subject to flood damage. While this alternative would be effective in helping to stem the rate of growth of average annual flood damages it would do little to aid those persons already residing in the Skagit flood plain.

11. Flood damages with flood plain management would grow to $6,353,000 by the year 2027, or about 30 percent less than under alternative 1. The benefit-cost ratio of alternative 2 is very favorable at 3.1, thereby justifying continuation of the existing program. However, flood plain management of itself would not meet planning objectives.

12. Alternative 3 - Flood Plain Management with Additional Flood Control Storage at Upper Baker Project. This proposal takes advantage of the capability of Puget Power's existing Upper Baker project to reduce Skagit River peak discharges during major flood events. The project operation would be changed through lowering of the reservoir during the winter flood season, providing flood storage space in addition to the 16,000 acre-feet now provided as replacement for natural valley storage lost when the project was constructed. Flood plain management, defined under alternative 2, also is part of this proposal.

13. With alternative 3 nearly 100,000 acres of urban and agricultural lands would experience a limited reduction in flood hazard during the winter flood season. Average annual flood damages in the year 2027 would amount to $4,819,000 with the additional flood control space at Upper Baker project or about 24 percent less than that expected under alternative 2. For additional flood control storage at Upper Baker project average annual existing benefits of $1,004,000 ($1,127,000 with future benefits) exceed the average annual costs of $434,000, giving a benefit-cost ratio of 2.3 to 1 (2.6 to 1 with future benefits). This alternative would achieve the planning objectives.

Display of Alternative Plan Effects

14. The "Principles and Standards for Planning Water and Related Land Resources," published by the Water Resource Council in the Federal Registar, Monday, 10 September 1973, and made effective 25 October 1973, requires a system of public information accounts to display the benefical and adverse effects of each plan considered on the dual planning objectives of national economic development and environmental quality, as well as effects on regional development and social well-being. This display should show the different levels of achievement of each objective so that the effects can be readily discerned and the trade-offs between alternative plans compared. Tables D-1, D-2, and D-3 display the beneficial and adverse effects of each of the alternatives considered during the plan formulation process.

15. Regions Displayed. The Principles and Standards require the display of all regions in which a significant portion of any beneficial or adverse impact is felt. Of the regions suggested for inclusion in the tables and defined below, only the planning area, the remainder of the nation, and the national summary are shown. No significant effects occur in the area served, the physical impact area, the remainder of the study authority area, and the relevant OBERS area and these regions are not displayed. The following paragraphs define the regions and explain their inclusion or deletion.

a. Planning Area. The Planning Area is that area where physical structures are located. The area should be specified in terms of a county, city or other local jurisdiction. In this study, the Planning Area is Skagit County with the objective of reducing flood damages on the Skagit River flood plain.

b. Area Served. The Area Served is that area other than the Planning Area where direct beneficial impacts would occur. No direct beneficial impacts are expected outside of Skagit County and, consequently, this region is not displayed.

c. Physical Impact Area. The Physical Impact Area is an area other than the Planning Area or the Area Served where the natural environment is significantly affected by either a direct physical action or by an associated socieconomic change. No significant impacts are expected on the natural environment beyond the Planning Area and, therefore, this region is not displayed.

d. Remainder of Study Authority Area. The Study Authority Area for this study includes the entire Skagit River basin. Since no significant impacts are expected outside of Skagit County, this region is not displayed.

e. OBERS Area. The OBERS Area for this study is subarea #1714, which consists of the entire Puget Sound region. Since no significant effects would occur within the area outside of Skagit County, this region is not displayed.

f. Remainder of Nation. In the study, the Remainder of Nation refers to all effects that would occur outside of Skagit County, Washington. Display of this region is a mandatory requirement of the Principles and Standards.

16. Qualifiers. To provide the reader a more accurate understanding of the effects listed in the tables, certain qualifiers have been used. The general format of the tables includes a descriptive statement of a given effect and then a yes or no statement indicating whether that effect exists in the region. Where possible, quantification has been provided. In addition, other qualifiers, such as timing, income class, uncertainty, double classification, actual or potential effect, and designation of effects required for evaluation under Section 122 of Public Law 91-611, have also been provided. The coding used in describing each of these qualifiers follows.

QUALIFIERS USED IN TABLES

Code	Meaning
	GENERAL
YES	Effect occurs in region shown.
NO	Effect does not occur in region.
NA	Effect is not applicable to the region.
NQ	Effect has not been quantified.
NE	Effect has not been evaluated.

QUALIFIERS USED IN TABLES (con.)

Code	Meaning
	GENERAL (con.)
*	Effect is specifically designated in Section 122 of Public Law 91-611 as one which must be identified and evaluated. (The effect is asterisked on attachment C, page A-11, of ER 1105-2-150, Guidelines for Assessment of Economic, Social, and Environmental Effects.)
	TIMING
I	Impact occurs prior to or during plan implementation.
II	Impact occurs within 10 years after plan implementation.
III	Impact occurs between 10 and 25 years after plan implementation.
IV	Impact occurs between 25 and 50 years after plan implementation.
V	Impact occurs more than 50 years after plan implementation.
+	Impact occurs at indicated period and continues for an indefinite future period.
	UNCERTAINTY
a	Level of uncertainty associated with the impact is greater than 50 percent because of data limitations or inadequacy of theoretical framework or methodology.
b	Level of uncertainty is between 10 and 50 percent.
c	Level of uncertainty is less than 10 percent.
	DOUBLE CLASSIFICATION
F	The social well-being, environmental quality, or regional development effect has been fully monetized and counted as a national economic development effect.
P	The effect has been partially monetized.
	ACTUAL OR POTENTIAL EFFECT
A	Impact will occur as a result of implementing the alternative.
B	The impact is likely to occur because of planned action by another agency or entity.
C	The impact will not occur because necessary additional actions by another agency or entity will not be forthcoming.

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING

PLAN DATA: 1. This would be a negative plan with existing flood plain management program discontinued.

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation Total	Summary of Nation By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
NATIONAL ECONOMIC DEVELOPMENT							
FLOOD DAMAGES							
Present conditions:							
Average annual flood damages	I	$4,246,000 1/	NO	$4,246,000			
Annual residual damages	I	4,246,000	NO	4,246,000			
Annual inundation (flood damage) reduction	I	0 c,A	0	0			
Analysis Period (1977 to 2077):							
Average annual flood damages	II+	$5,554,000 1/	NO	$5,554,000			
Annual residual damages	II+	5,554,000 1/	NO	5,554,000			
Annual inundation (flood damage) reduction		0 1/ b,A	0	0			
AVERAGE ANNUAL BENEFITS							
Existing inundation reduction:	II+	0	0	0			
Area redevelopment:	I	0	0	0			
Total existing benefits:		0	0	0			
Future inundation reduction:	II+	0	0	0			
Elimination of future flood proofing costs:	II+	0	0	0			
Total with future benefits:		0	0	0			

NOTE: Based on 1970 census, average family income for Skagit County is about $11,000. Data grouped by income class within the flood plain is not available.

1/Data for area protected by alternative 3 (99,450 acres) only.

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
NATIONAL ECONOMIC DEVELOPMENT (con.)							
IMPLEMENTATION COST	I	0	0	0		NA	
INVESTMENT COST	I	0	0	0		NA	
AVERAGE ANNUAL COST	I	0	0	0		NA	
JUSTIFICATION (BENEFIT-COST RATIO)							
Existing Conditions:		NA	NA	NA		NA	
With Future Benefits:		NA	NA	NA		NA	
ENVIRONMENTAL QUALITY							
* ESTHETIC VALUES							
Retains agricultural open space that can be coordinated with local park plans.	I+	NO b	NO b	NO b		NA	
Exposes unsightly Baker Lake shoreline earlier than in the past.	I+	NO c	NO c	NO c		NA	
Increases siltation along Baker Lake shoreline.	I+	NO c	NO c	NO c		NA	
ESTUARIES							
Disruption of land/river interface.	I+	NO c	NO c	NO c		NA	

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
ARCHEOLOGICAL/HISTORICAL RESOURCES							
Disturbs known archeological or historical resources.	I+	NO c	NO c	NO c		NA	
BIOLOGICAL RESOURCES							
Disrupts fish habitat along Skagit River.	I+	YES c	NO c	NO c		NA	
Reduces sockeye salmon spawning losses in Baker Lake.	I+	NO c	NO c	NO c		NA	
* AIR QUALITY							
Creates temporary air and noise pollution during plan implementation.	I	NO c	NO c	NO c		NA	
* WATER QUALITY							
Reduces water ponded in natural channel during flood conditions.	II+	NO c	NO c	NO c		NA	
Relieves overloaded storm and sanitary sewers during flood conditions.	II+	NO c	NO c	NO c		NA	
Encourages increase in residential sewage flows by providing flood-free area for future construction.	II+	NO c	NO c	NO c		NA	

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
* WATER QUALITY (con.)							
Discourages increase in residential sewage flows due to zoning restrictions.	I+	NO c	NO c	NO c		NA	
Encourages increase in industrial waste discharges.	I+	YES c	NO c	YES c		NA	
LAND QUALITY							
* Commits natural resources such as earth materials for plan implementation.	I+	NO c	NO c	NO c		NA	
* Commits manmade resources such as concrete, steel, etc., for plan implementation.	I+	NO c	NO c	NO c		NA	
Commits labor and capital involved in plan implementation.	I+	NO c	NO c	NO c		NA	
Commits right-of-way to public ownership.	I+	NO c	NO c	NO c		NA	
Conserves materials used in manufactured items that would have been destroyed by future floods.	II+	NO c	NO c	NO c		NA	

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
LAND QUALITY (con.)							
Compatible with National Wild and Scenic River designation of Skagit River in recreation status below mouth of Baker River.	II+	NO c	NO c	NO c		NA	
REGIONAL DEVELOPMENT							
INCOME							
Increases as output of goods and service to users residing in area.	II+	NO c	NO c	NO c		NA	
Increases as output in area resulting from use of labor resources unemployed or underemployed.	I	NO c	NO c	NO c		NA	
Increases as net income to the area from expenditures by imported construction workers.	I	NO c	NO c	NO c		NA	
Requires expenditure of resources from region for plan implementation.	I+	NO c	NO c	NO c		NA	
Increases other regional income during plan implementation.	II+	NO c	NO c	NO c		NA	

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
REGIONAL DEVELOPMENT (con.)							
* EMPLOYMENT							
Increases net employment in area during plan implementation.	I	NO c	NO c	NO c		NA	
Increases other employment in the area.	I	NE	NE	NE		NA	
POPULATION DISTRIBUTION							
Encourages increase in population in flood plain.	II+	YES c	NO c	YES c		NA	
* DESIRABLE COMMUNITY AND RECREATIONAL GROWTH							
Increases rate of land development on flood plain.	II+	YES c	NO c	YES c		NA	
Encourages development in already developed or partially developed flood plain areas.	II+	YES c	NO c	YES c		NA	
Contributes to community development by reducing depressing economic effects of flood damages.	II+	NO c	NO c	NO c		NA	
Removes restriction on Federally related financing for existing flood-prone properties.	II+	NO c	NO c	NO c		NA	
Reduces flood insurance premiums.	II+	YES c	NO c	YES c		NA	

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TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
REGIONAL DEVELOPMENT (con.)							
* DESIRABLE COMMUNITY AND RECREATIONAL GROWTH (con.)							
Guides future land use.	II+	NO c	NO c	NO c		NA	
Compatible with county's plans for future development.	II+	NO c	NO c	NO c		NA	
* Increases industrial activity.	II+	NO c	NO c	NO c		NA	
* TAXES AND GOVERNMENT EXPENDITURES							
Increases property values, business activity and tax revenues.	II+	NO c	NO c	NO c		NA	
Encourage municipal expenditures to improve community facilities (parks, streets, sidewalks, sewers, etc.).	II+	NO c	NO c	NO c		NA	
Reduces municipal expenditures for flood fighting and repair of flood-damaged utilities.	II+	NO c,F	NO c	NO c,F		NA	
SOCIAL WELL-BEING							
REAL INCOME							
Real income of flood plain residents increases due to plan implementation.	II+	NO c	NO c	NO c		NA	

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
SOCIAL WELL-BEING (con.)							
* DISPLACEMENT OF PEOPLE							
Requires relocation of residences.	I	NO c	NO c	NO c		NA	
Requires relocation of other buildings.	I	NO c	NO c	NO c		NA	
LIFE, HEALTH, AND SAFETY							
Reduces flood damages.	II+	NO c,F	NO c	NO c,F		NA	
Provides increased level of flood protection for residents.	II+	NO c	NO c	NO c		NA	
Continues existing level of threat to life caused by floods for residents.	II+	YES c	NO c	YES c		NA	
PUBLIC FACILITIES AND SERVICES							
Increases flood protection of public facilities (schools, fire station, parks).	II+	NO c	NO c	NO c		NA	
Increases flood protection of public services (water, sewer, power, public safety).	II+	NO c	NO c	NO c		NA	
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES							
Increases public accessibility to Skagit River edge.	II+	NO c	NO c	NO c		NA	

TABLE D-1

EFFECTS OF ALTERNATIVE 1 - DO NOTHING (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation Total	Summary of Nation By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
SOCIAL WELL-BEING (con.)							
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES (con.)							
Provides area for walking, bicyclying, and passive recreation.	II+	NO c	NO c	NO c		NA	
Encourages park development in existing flood plain.	II+	NO c	NO c	NO c		NA	
EMERGENCY PREPAREDNESS							
Reduces flood fighting operations.	II+	NO c	NO c	NO c		NA	

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE

PLAN DATA: 1. Existing State and county flood hazard zoning and flood proofing all of new structures in flood-prone areas.
2. Federal flood insurance program which precludes Federally insured financing in absence of local government qualification for insurance program.

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation Total	Summary of Nation By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
NATIONAL ECONOMIC DEVELOPMENT							
FLOOD DAMAGES							
Present conditions:							
Average annual flood damages	I	$4,246,000	NO	$4,246,000			
Annual residual damages	I	4,246,000	NO	4,246,000			
Annual inundation (flood damage) reduction	I	0 c,A	0	0			
Analysis Period (1977 to 2077):							
Average annual flood damages	II+	$5,554,000	NO	$5,554,000			
Annual residual damages	II+	4,766,000	NO	4,766,000			
Annual inundation (flood damage) reduction	II+	$788,000 b,A	0	$788,000			
AVERAGE ANNUAL BENEFITS							
Existing inundation reduction:	II+	0	0	0			
Area redevelopment:	I	0	0	0			
Total existing benefits:		0 c,A	0	0 c,A			
Future inundation reduction:	II+	$788,000	0	$788,000			
Flood insurance payment:	II+	270,000	0	270,000			
Total with future benefits:		$1,058,000 b,A		$1,058,000 b,A			

NOTE: Based on 1970 census, median family income for Skagit County is about $11,000. Data grouped by income class within the flood plain is not available.

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
NATIONAL ECONOMIC DEVELOPMENT (con.)							
IMPLEMENTATION COST	I	0[1/]	0	0		NA	
INVESTMENT COST	I+	0[1/]	0	0		NA	
AVERAGE ANNUAL COST	I+	$341,000	0	$341,000		NA	
JUSTIFICATION (BENEFIT-COST RATIO)							
Existing Conditions:		NA	NA	NA		NA	
With Future Benefits:		3.10 b	NA	3.10 b		NA	
ENVIRONMENTAL QUALITY							
* ESTHETIC VALUES							
Retains agricultural open space that can be coordinated with local park plans.	I+	YES b	NO b	YES b		NA	
Exposes unsightly Baker Lake shoreline earlier than in the past.	I+	NO c	NO c	NO c		NA	
Increases siltation along Baker Lake shoreline.	I+	NO c	NO c	NO c		NA	
ESTUARIES							
Disruption of land/river interface.	I+	NO c	NO c	NO c		NA	

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation Total	Summary of Nation By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
ARCHEOLOGICAL/HISTORICAL RESOURCES							
Disturbs known archeological or historical resources.	I+	NO c	NO c	NO c		NA	
BIOLOGICAL RESOURCES							
Disrupts fish habitat along Skagit River.	I+	NO c	NO c	NO c		NA	
Reduces sockeye salmon spawning losses in Baker Lake.	I+	NO c	NO c	NO c		NA	
* AIR QUALITY							
Creates temporary air and noise pollution during plan implementation.	I	NO c	NO c	NO c		NA	
* WATER QUALITY							
Reduces water ponded in natural channel during flood conditions.	II+	NO c	NO c	NO c		NA	
Relieves overloaded storm and sanitary sewers during flood conditions.	II+	NO c	NO c	NO c		NA	
Encourages increase in residential sewage flows by providing flood-free area for future construction.	II+	NO c	NO c	NO c		NA	

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
* WATER QUALITY (con.)							
Discourages increase in residential sewage flows due to zoning restrictions.	I+	YES c,A	NO c	YES c,A		NA	
Encourages increase in industrial waste discharges.	I+	YES c	NO c	YES c		NA	
LAND QUALITY							
* Commits natural resources such as earth materials for plan implementation.	I+	YES c,F,A	YES c	YES c,F,A		NA	
* Commits manmade resources such as concrete, steel, etc., for plan implementation.	I+	YES c,F,A	YES c,F,A	YES c,F,A		NA	
Commits labor and capital involved in plan implementation.	I+	YES c,F,A	YES c	YES c,F,A		NA	
Commits right-of-way to public ownership.	I+	NO c	NO c	NO c		NA	
Conserves materials used in manufactured items that would have been destroyed by future floods.	II+	YES c,F,A	NO c	YES c,F,A		NA	

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
LAND QUALITY (con.)							
Compatible with National Wild and Scenic River designation of Skagit River in recreation status below mouth of Baker River.	II+	YES c	NO c	YES c		NA	
REGIONAL DEVELOPMENT							
INCOME							
Increases as output of goods and service to users residing in area.	II+	YES-NQ c,A	NO c	YES-NQ c,A		NA	
Increases as output in area resulting from use of labor resources unemployed or underemployed.	I	NO b,F,A	NO c	NO b,F,A		NA	
Increases as net income to the area from expenditures by imported construction workers.	I	NO b,A	NO c	NO b,A		NA	
Requires expenditure of resources from region for plan implementation.	I+	YES[1/]-NQ c,A	NO c	YES-NQ c,A		NA	
Increases other regional income during plan implementation.	II+	NO c	NO c	NO c		NA	

1/Flood proofing costs of future development.

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
REGIONAL DEVELOPMENT (con.)							
* EMPLOYMENT							
Increases net employment in area during plan implementation.	I	NO c	NO c	NO c		NA	
Increases other employment in the area.	I	NO	NO	NO		NA	
POPULATION DISTRIBUTION							
Encourages increase in population in flood plain.	II	NO c	NO c	NO c		NA	
* DESIRABLE COMMUNITY AND RECREATIONAL GROWTH							
Increases rate of land development on flood plain.	II	NO c	NO c	NO c		NA	
Encourages development in already developed or partially developed flood plain areas.	II	NO c	NO c	NO c		NA	
Contributes to community development by reducing depressing economic effects of flood damages.	II	YES b,F,A	NO c	YES b,F,A		NA	
Removes restriction on Federally related financing for existing flood-prone properties.	II	YES c,B	NO c	YES c,B		NA	
Reduces flood insurance premiums.	II+	NO c	NO c	NO c		NA	

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
REGIONAL DEVELOPMENT (con.)							
* DESIRABLE COMMUNITY AND RECREATIONAL GROWTH (con.)							
Guides future land use.	II+	YES c,A	NO c	YES c,A		NA	
Compatible with county's plans for future development.	II+	NO c	NO c	NO c		NA	
* Increases industrial activity.	II+	NO c	NO c	NO c		NA	
* TAXES AND GOVERNMENT EXPENDITURES							
Increases property values, business activity and tax revenues.	II+	NO c	NO c	NO c		NA	
Encourage municipal expenditures to improve community facilities (parks, streets, sidewalks, sewers, etc.).	II+	NO c	NO c	NO c		NA	
Reduces municipal expenditures for flood fighting and repair of flood-damaged utilities.	II+	YES[1/] c	NO c	YES c		NA	
SOCIAL WELL-BEING							
REAL INCOME							
Real income of flood plain residents increases due to plan implementation.	II+	YES-NQ b,A	NO c	YES-NQ b,A		NA	

1/Assumes future public utilities will be flood proofed to extent possible.

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
SOCIAL WELL-BEING (con.)							
* DISPLACEMENT OF PEOPLE							
Requires relocation of residences.	I	NO c	NO c	NO c		NA	
Requires relocation of other buildings.	I	NO c	NO c	NO c		NA	
LIFE, HEALTH, AND SAFETY							
Reduces flood damages.	II+	YES b,F,A	NO c	YES b,F,A		NA	
Provides increased level of flood protection for residents.	II+	NO c	NO c	NO c		NA	
Continues existing level of threat to life caused by floods for residents.	II+	YES c	YES c	YES c		NA	
PUBLIC FACILITIES AND SERVICES							
Increases flood protection of public facilities (schools, fire station, parks).	II+	NO c	NO c	NO c		NA	
Increases flood protection of public services (water, sewer, power, public safety).	II+	NO c	NO c	NO c		NA	
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES							
Increases public accessibility to Skagit River edge.	II+	NO c	NO c	NO c		NA	

TABLE D-2

EFFECTS OF ALTERNATIVE 2 - FLOOD PLAIN MANAGEMENT ALONE (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
SOCIAL WELL-BEING (con.)							
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES (con.)							
Provides area for walking, bicyclying, and passive recreation.	II+	NO c	NO c	NO c		NA	
Encourages park development in existing flood plain.	II+	YES a,B	NO c	YES a,B		NA	
EMERGENCY PREPAREDNESS							
Reduces flood fighting operations.	II+	YES b,A	NO	YES b,A		NA	

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH
ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT

PLAN DATA: 1. Existing State and county flood hazard zoning and flood proofing all new structures in flood-prone areas.
b. Federal flood insurance program which precludes Federally insured financing in absence of local government qualification for insurance program.
3. No new structure; use made of 58,000 acre-feet of Puget Power's Upper Baker Project storage capacity.

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation Total	Summary of Nation By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
NATIONAL ECONOMIC DEVELOPMENT							
FLOOD DAMAGES							
Present conditions:							
Average annual flood damages	I	$4,246,000 1/	NO	$4,246,000			
Annual residual damages	I	3,242,000 1/	NO	3,242,000			
Annual inundation (flood damage) reduction	I	$1,004,000 1/ c,A	0	$1,004,000			
Analysis Period (1977 to 2077):							
Average annual flood damages	II+	$4,766,000 1/	NO	$4,766,000			
Annual residual damages		3,639,000 1/	NO	3,639,000			
Annual inundation (flood damage) reduction		$1,127,000 1/ b,A	0	$1,127,000			
AVERAGE ANNUAL BENEFITS							
Existing inundation reduction:	II+	$1,004,000	0	$1,004,000			
Area redevelopment:		0	0	0			
Total existing benefits:		$1,004,000	0	$1,004,000			
Future inundation reduction:	II+	$1,127,000	0	$1,127,000			
Elimination of future flood proofing costs:	II+	YES-NQ	0	YES-NQ			
Total with future benefits:		$1,127,000	0	$1,127,000			

NOTE: Based on 1970 census, median family income for Skagit County is about $11,000. Data grouped by income class within the flood plain is not available.

1/Data reflects conditions with additional flood control storage at Upper Baker project being second added to existing flood plain management program.

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation Total	Summary of Nation By Income Class (%) Below $4,000	$4,000 to $12,000	Above $12,000
NATIONAL ECONOMIC DEVELOPMENT (con.)							
IMPLEMENTATION COST	I	$21,000[1/]	0	$21,000		NA	
INVESTMENT COST	I+	$21,000	0	$21,000		NA	
AVERAGE ANNUAL COST	I+	$434,000	0	$434,000		NA	
JUSTIFICATION (BENEFIT-COST RATIO)							
Existing Conditions:		2.31	NA	2.31		NA	
With Future Benefits:		2.60	NA	2.60		NA	
ENVIRONMENTAL QUALITY							
* ESTHETIC VALUES							
Retains agricultural open space that can be coordinated with local park plans.	I+	YES b	NO c	YES b		NA	
Exposes unsightly Baker Lake shoreline earlier than in the past.	I+	YES c	NO c	NO c		NA	
Increases siltation along Baker Lake shoreline.	I+	YES c	NO c	YES c		NA	
ESTUARIES							
Disruption of land/river interface.	I+	NO c	NO c	NO c		NA	

1/ Data reflects conditions with additional flood control storage at Upper Baker project being second added to existing flood plain management program. Costs are those associated with negotiation of power loss evaluation agreement and preparation of reservoir regulation manual (see page F-3).

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
ARCHEOLOGICAL/HISTORICAL RESOURCES Disturbs known archeological or historical resources.	I	NO c	NO c	NO c		NA	
BIOLOGICAL RESOURCES Disrupts fish habitat along Skagit River.	I+	NO c	NO c	NO c		NA	
Reduces sockeye salmon spawning losses in Baker Lake.	I+	YES c	NO c	YES c		NA	
* AIR QUALITY Creates temporary air and noise pollution during plan implementation.	I	NO c	NO c	NO c		NA	
* WATER QUALITY Reduces water ponded in natural channel during flood conditions.	II+	NO c	NO c	NO c		NA	
Relieves overloaded storm and sanitary sewers during flood conditions.	II+	YES c	NO c	YES c		NA	
Encourages increase in residential sewage flows by providing flood-free area for future construction.	II+	NO c	NO c	NO c		NA	

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
* WATER QUALITY (con.)							
Discourages increase in residential sewage flows due to zoning restrictions.	I+	YES c	NO c	YES c		NA	
Encourages increase in industrial waste discharges.	I+	NO c	NO c	NO c		NA	
LAND QUALITY							
* Commits natural resources such as earth materials for plan implementation.	I+	YES 1/ c	NO c	YES c		NA	
* Commits manmade resources such as concrete, steel, etc., for plan implementation.	I+	YES c	NO c	YES c		NA	
Commits labor and capital involved in plan implementation.	I+	YES c	NO c	YES c		NA	
Commits right-of-way to public ownership.	I+	NO c	NO c	NO c		NA	
Conserves materials used in manufactured items that would have been destroyed by future floods.	II+	YES c	NO c	YES c		NA	

1/Flood proofing of future development.

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TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
ENVIRONMENTAL QUALITY (con.)							
LAND QUALITY (con.)							
Compatible with National Wild and Scenic River designation of Skagit River in recreation status below mouth of Baker River.		YES c	NO c	YES c		NA	
REGIONAL DEVELOPMENT							
INCOME							
Increases as output of goods and service to users residing in area.	II+	YES c	NO c	YES c		NA	
Increases as output in area resulting from use of labor resources unemployed or underemployed.	I	NO c	NO c	NO c		NA	
Increases as net income to the area from expenditures by imported construction workers.	I	NO c	NO c	NO c		NA	
Requires expenditure of resources from region for plan implementation.	I+	NO c	NO c	NO c		NA	
Increases other regional income during plan implementation.	I+	NE	NE	NE		NA	

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
REGIONAL DEVELOPMENT (con.)							
* EMPLOYMENT							
Increases net employment in area during plan implementation.	I	NO c	NO c	NO c		NA	
Increases other employment in the area.	I	NE	NE	NE		NA	
POPULATION DISTRIBUTION							
Encourages increase in population in flood plain.	II	NO c	NO c	NO c		NA	
* DESIRABLE COMMUNITY AND RECREATIONAL GROWTH							
Increases rate of land development on flood plain.	II	NO c	NO c	NO c		NA	
Encourages development in already developed or partially developed flood plain areas.	II	NO c	NO c	NO c		NA	
Contributes to community development by reducing depressing economic effects of flood damages.	II	YES c,F,A	NO c	YES c,F,A		NA	
Removes restriction on Federally related financing for existing flood-prone properties.	II	YES c,B	NO c	YES c,B		NA	
Reduces flood insurance premiums.	II+	YES c,A	NO c	YES c,A		NA	

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
REGIONAL DEVELOPMENT (con.)							
* DESIRABLE COMMUNITY AND RECREATIONAL GROWTH (con.)							
Guides future land use.	II+	YES c,A	NO c	YES c,A		NA	
Compatible with county's plans for future development.	II+	YES c	NO c	YES c		NA	
* Increases industrial activity.	II+	NO c	NO c	NO c		NA	
* TAXES AND GOVERNMENT EXPENDITURES							
Increases property values, business activity and tax revenues.	II+	YES b	NO c	YES b		NA	
Encourage municipal expenditures to improve community facilities (parks, streets, sidewalks, sewers, etc.).	II+	YES b	NO c	YES b		NA	
Reduces municipal expenditures for flood fighting and repair of flood-damaged utilities.	II+	YES c,F	NO c	YES c,F		NA	
SOCIAL WELL-BEING							
REAL INCOME							
Real income of flood plain residents increases due to plan implementation.	II+	YES-NQ c	NO c	YES-NQ c		NA	

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
					By Income Class (%)		
				Total	Below $4,000	$4,000 to $12,000	Above $12,000
SOCIAL WELL-BEING (con.)							
* DISPLACEMENT OF PEOPLE							
Requires relocation of residences.	I	NO c	NO c	NO c		NA	
Requires relocation of other buildings.	I	NO c	NO c	NO c		NA	
LIFE, HEALTH, AND SAFETY							
Reduces flood damages.	II+	YES c,F,A	NO c	YES c,F,A		NA	
Provides increased level of flood protection for residents.	II+	NO c	NO c	NO c		NA	
Continues existing level of threat to life caused by floods for residents.	II+	NO c,F,A	NO c	NO c,F,A		NA	
PUBLIC FACILITIES AND SERVICES							
Increases flood protection of public facilities (schools, fire station, parks).	II+	YES c,F,A	NO c	YES c,F,A		NA	
Increases flood protection of public services (water, sewer, power, public safety).	II+	YES c,F,A	NO c	YES c,F,A		NA	
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES							
Increases public accessibility to Skagit River edge.	II+	YES c	NO c	YES c		NA	

TABLE D-3

EFFECTS OF ALTERNATIVE 3 - FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT (con.)

	Timing	Planning Area (Skagit County)	Remainder of Nation	Summary of Nation			
				Total	By Income Class (%)		
					Below $4,000	$4,000 to $12,000	Above $12,000
SOCIAL WELL-BEING (con.)							
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES (con.)							
Provides area for walking, bicyclying, and passive recreation.	II+	NO c	NO c	NO c		NA	
Encourages park development in existing flood plain.	II+	YES a,B	NO c	YES a,B		NA	
EMERGENCY PREPAREDNESS							
Reduces flood fighting operations.	II+	YES c,F,A	NO c	YES c,F,A		NA	

Alternatives Considered Futher

17. At the 25 April 1973 public meeting, general agreement was expressed on the desirability of additional flood control at the Upper Baker project (alternative 3). Subsequently, further detailed engineering, economic, and environmental impact studies were limited to this proposal, with various amounts of storage space at the Upper Baker project examined. However, Alternative 2, Flood Plain Management Alone, was retained as an option throughout the study.

18. The various volumes of additional storage space considered during detailed studies of alternative 3 are presented in table D-4.

TABLE D-4
ADDITIONAL FLOOD CONTROL
SPACE AT UPPER BAKER PROJECT

Storage Space (acres-feet)	
Additional	Total
40,000	56,000
50,000	66,000
58,000	74,000
84,000	100,000

19. Reservoir drawdown schedules were developed for each variation of additional storage space. The schedules were based on a review of historical floods. Full flood control capacity from 15 November to 1 March would be required in order to assure that future winter flood discharges for the Baker River are controlled. Drawdown to provide flood control storage space in addition to the 16,000 acre-feet now available would begin on 1 November, the latest this drawdown should occur for flood control purposes. Earlier lowering of Baker Lake would increase power losses with little or no increase in effective flood control.

Selecting a Plan

20. Selection of the best plan for accomplishing additional flood damage reduction in the Skagit River basin at this time involved

evaluating the economic and environmental impacts of each of the Upper Baker project additional flood control storage volumes considered. Criteria outlined earlier were used in the formulation and evaluation process.

21. The various storage volumes were evaluated in terms of their effectiveness in controlling the 100-year flood event of the Skagit River at Concrete. Additional storage of 58,000 acre-feet, or total flood control storage of 74,000 acre-feet, was found to produce maximum net benefits (benefits over costs).

22. Current environmental impacts of the Upper Baker project would not be significantly altered by any of the various flood control storage schemes considered. Baker Lake has been drawn down as much as 64 feet below full pool within the past 4 years for hydroelectric power generation purposes. Maximum required drawdown below full pool considered during studies of alternative flood control storage volumes was about 23 feet to provide 100,000 (84,000 additional) acre-feet of flood control storage.

23. The only departure from past project operation would be an earlier drawdown, which may help reduce sockeye salmon egg losses now occurring as a result of adult fish spawning along Baker Lake shoreline (above elevation 700) during fall and early winter months. Earlier drawdown should reduce deposition of fish eggs which later are exposed to the atmosphere. Follow-up monitoring studies would evaluate this expectation.

24. Management by Skagit County and the State of Washington of the Skagit River flood plain would be required for any of the storage volumes considered. Even though additional flood control storage at the Upper Baker project would increase flood protection for the lower Skagit valley, the potential for major flooding would remain. The level of protection provided Mount Vernon would be increased from the current 10-year recurrence interval to a 15-year recurrence interval.

25. After evaluating economic and environmental aspects of each variation in storage, 58,000 acre-feet of additional flood control storage at the Upper Baker project in combination with flood plain management was found to be the best solution for reducing future flood damages in the Skagit Basin. This proposal (discussed in more detail in "The Recommended Plan") is consistent with Skagit County's adopted comprehensive flood control plan and the Pacific Northwest River Basins Commission's Comprehensive Water and Related Land Resources plan for the Puget Sound area.

THE RECOMMENDED PLAN

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E-1	UPPER BAKER REGULATION OF SKAGIT RIVER 100-YEAR FLOOD

THE RECOMMENDED PLAN

1. The preceding section reviewed the various steps involved in plan formulation, identified the alternatives considered, and provided the basis for the selection of the recommended plan. The following discussion will present a broad description of the recommended plan, including its accomplishments and effects, as well as its significant operational features.

Plan Description

2. Combined with the effective flood plain management program being implemented by Skagit County, communities within the Skagit basin, and the State of Washington, additional flood control storage at Baker Lake would be the first major new element in Skagit County's Comprehensive Flood Control Plan. The Federal Power Commission license for the Upper Baker project contains provisions for additional flood control. Accordingly, the only action now required is for Congress to authorize Federal compensation of Puget Power for annual power losses that may result from the additional flood control. There are no actions required on the part of Skagit County or other local entities necessary to implement the proposal discussed herein, except to reaffirm their intention of continuing sound flood plain management practices.

3. The recommended plan includes the following features:

a. Drawdown of Baker Lake from 1 October to 1 November to provide 16,000 acre-feet of storage (El. 720.6) as replacement for valley storage lost when the project was constructed.

b. Additional drawdown of Baker Lake from 1 November to 15 November to reach a level at which a total of 74,000 acre-feet of storage capacity (El. 707.8) would be available for flood control.

c. Storage capacity of 74,000 acre-feet would be reserved for flood control until the first of March, except when regulating for flood control. Puget Power could still draw the reservoir below elevation 707.8 during this period for power production

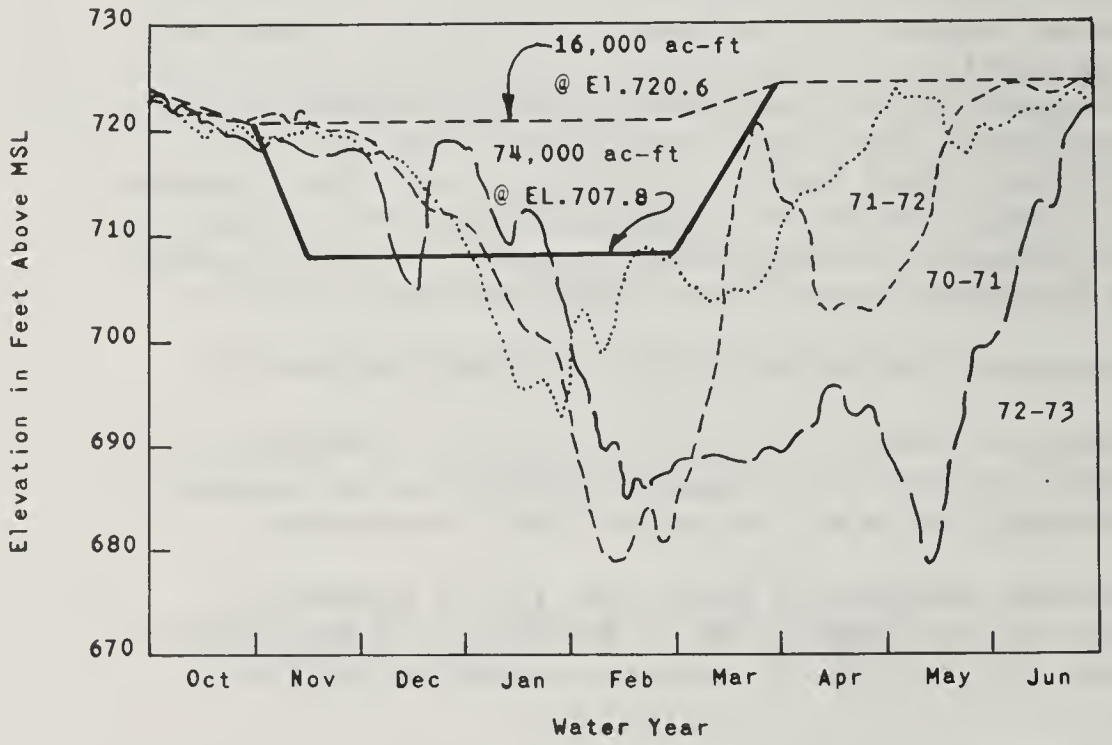
purposes. The required flood control storage capacity would be gradually reduced during March to permit Puget Power to refill to full pool (El. 724) by 1 April.

d. The Baker River's discharge into the Skagit River at Concrete would be regulated to a maximum of 5,000 c.f.s. (present power generation capacity) whenever the Skagit River is forecast to reach 90,000 c.f.s. near Concrete.

e. Flood plain management by Skagit County and communities of Burlington, Mount Vernon, La Conner, Sedro Woolley, Hamilton, etc., consistent with the State of Washington Flood Control Zone Act of 1935 and the State of Washington Shoreline Management Act of 1971, as well as requirements of the Department of Housing and Urban Development, Flood Insurance Administration.

4. The area that would be benefited by the plan is that portion of the Skagit River flood plain located below the confluence of the Baker and Skagit Rivers, extending down to Padilla and Skagit Bays. This is shown on plate 1.

5. Puget Power would operate the Upper Baker project as directed by the District Engineer, Seattle District, Corps of Engineers, to regulate floods consistent with the 74,000 acre-foot flood control rule curve shown below.



UPPER BAKER PROJECT RESERVOIR ELEVATION

(HISTORICAL DRAWDOWN AND FLOOD CONTROL
RULE CURVES UNDER 16,000 ACRE-FEET (EXISTING)
AND 74,000 ACRE-FEET (PROPOSED CONDITIONS)

Plan Accomplishments

6. The major benefits that will result from the recommended plan are reduction of existing and future damages throughout the Skagit River flood plain, including the more intensively developed areas of Mount Vernon, Burlington, Sedro Woolley, and La Conner. The change in operation of the Upper Baker River project would reduce floodflows and attendant damages on approximately 99,450 acres of land during a 100-year flood event. Approximately 80,250 acres would be benefited by the project during a 10-year event. The land use distribution in the 10- and 100-year flood plains is shown in the following tabulation:

Land Use	10-Year Flood (acres)	100-Year Flood (acres)
Residential	1,000	1,600
Commercial/industrial	750	1,050
Roads & public facilities	2,400	3,200
Agricultural	71,800	87,200
Other	4,300	6,400
Total	80,250	99,450

7. The Baker project would reduce the $4,246,000 in average annual damages under 1974 prices and conditions by an estimated $1,004,000 or about 24 percent. This reduction is viewed as the flood prevention benefits that would have been derived by the project if it would have been operated as proposed in 1974. Assuming the project operation change actually occurs in 1977, the flood prevention benefits in that year would be $1,024,000. An additional average annual benefit of $103,000 has been added to the base year benefit of $1,024,000 to reflect anticipated future growth in damages.

8. The total average annual flood prevention benefits of $1,127,000, which would accrue from the recommended plan, are well distributed over the entire flood plain. Over 3,600 separate ownerships were identified from a review of the Skagit County tax assessor's rolls.

Effect of the Plan on Environment

9. The primary effect of the recommended plan would be to increase the level of flood protection over nearly 100,000 acres of agricultural, residential, and commercial properties lying in the Skagit River flood plain below the mouth of the Baker River. As substantial flood threat would still remain, no increase in development of the flood plain is anticipated. While the peak discharge of the 100-year Skagit River flood event (gage - Skagit River near Mount Vernon) under current conditions would be reduced by 18,000 c.f.s. at Mount Vernon, the amount of land area covered by the regulated 100-year flood would not appreciably change due to the nature of the flood plain itself.

10. At the Upper Baker project, no change in physical features is called for by the recommended plan. Maximum operating level would still be elevation 724; the only difference is that the reservoir would be drawn down earlier than in the past, in order to insure that flood control storage space is available when needed. Maximum reservoir drawdown under the proposed flood control rule curve is not expected to be any greater than has been experienced historically for hydroelectric power generation. During high run years some of the sockeye salmon which are transported into Baker Lake from a fish collection facility located below Lake Shannon may be benefited by the change in project operation.

11. The Washington Department of Fisheries operates a fish spawning facility above the lake to compensate for spawning beds inundated at the time the project was constructed (see plate 2). Whenever a sockeye salmon run exceeds the capacity of the spawning facilities, some natural spawning occurs along the shore of Baker Lake during October and November. Normally, the reservoir is above elevation 720 during this spawning period. Significant drawdown for hydroelectric power generation generally begins in December which has, in years of large runs, resulted in exposed sockeye salmon redds and attendant egg losses. The proposed project operation change calls for an earlier drawdown than has been the case in the past; consequently, some reduction in the amount of salmon egg losses should result as adult fish are encouraged to seek out tributary streams for spawning.

12. During the drawdown period, the discharge of the Baker River would be increased an average of 1,900 c.f.s. Whenever the natural inflows to the lake are less than 3,100 c.f.s. (the hydraulic capacity of the Upper Baker generating plant is 5,000 c.f.s.), the drawdown would be entirely accommodated through the turbines.

When lake inflows equal or exceed 3,100 c.f.s., the reservoir drawdown would result in water being discharged over the spillway. However, the peak discharge over the spillway under a flood event would be considerably less under the recommended plan than would be the case under existing operating procedures. The relatively small increase in discharge during reservoir drawdown is not expected to result in any significant adverse impacts.

13. A separate draft environmental impact statement has been prepared for this report. It covers in detail the environmental considerations concerning the recommended plan and alternatives.

Other Plan Effects

14. Intangible benefits associated with the diminished flood potential are improved public health, reduced risk to human life, and increased morale of the people living in the flood plain.

Flood Regulation and Routing

15. Section C of this appendix presented information on historical streamflow characteristics, structural flood control measures, and reservoir storage. This section discusses in detail studies which dealt with additional flood control storage at the Upper Baker project. Additional storage at Baker Lake would supplement the flood control storage already reserved in Ross Reservoir. The existing plan for flood control regulation at Ross Dam would remain unchanged.

16. The effects of additional flood control storage at the Upper Baker project were examined by developing a hypothetical flood for the Baker and Skagit Rivers near Concrete and routing the flood downstream by Sedro Woolley and Mount Vernon. Routing characteristics were determined from experience with seven observed floods modeled on the computer for previous studies. Contribution from Baker River during Skagit River floods was estimated from a correlation of Baker River discharges coincident with maximum Skagit River discharges near Concrete. Baker River hypothetical hydrographs with and without regulation by additional storage at Baker Lake were combined with the 50-, 100-, and 200-year hypothetical hydrographs for Skagit River near Concrete. The 100-year flood was routed downstream to Sedro

Woolley and Mount Vernon to estimate the effect of additional flood control storage in Baker Lake. The 100-year flood hydrographs are plotted on plate E-1.

Upper Baker Regulation

17. Skagit River discharge reduction at Concrete would depend on the timing and the amount of storage space available in Upper Baker Reservoir. Flood regulation would begin when Skagit River discharge reaches the capacity of the river channel. The present safe channel capacity of the lower Skagit River, in the leveed areas below Burlington, is approximately 84,000 c.f.s. This corresponds to a discharge of 90,000 c.f.s. upstream near Concrete. Flood control would be coordinated with flood peak forecasts for the Skagit River near Concrete. Regulation would begin 8 hours prior to the forecasted unregulated flow reaching 90,000 c.f.s. near Concrete. The discharge from the Upper Baker project would be reduced to a minimum power generation release of 5,000 c.f.s. and held at this rate until after the Skagit River has peaked at Concrete. Subsequently, the Baker River discharge would be increased by releases from the Upper Baker project until full flood control storage space is regained. The Upper Baker project would be regulated during this time to avoid raising the Skagit River discharge above the peak experienced initially.

18. The flood frequency curves prepared for this report reflect an assumption of Upper Baker project being regulated as additive to Ross project regulation. Additional flood control regulation of Upper Baker Dam with Ross Dam regulation would increase the effective regulation from 22 to 34 percent in controlling the 100-year flood to 90,000 c.f.s. at Concrete.

Upper Baker Storage

19. The amount of flood control storage at Baker Lake required to reduce the peak at Concrete depends on the volume of Baker River inflow between the time when the Skagit River near Concrete (unregulated by Upper Baker project) is forecast to exceed 90,000 c.f.s. and when it peaks. Near Concrete, the Skagit River would take almost 1-1/2 days to peak during a 100-year flood. During this time, inflow to Baker Lake, in excess of 5,000 c.f.s., would be about 62,000 acre-feet,

requiring use of about 13 feet of reservoir capacity (between elevations 724 and 711). Storage of this volume, based on the average expectations of Baker River runoff associated with the 100-year flood event of the Skagit River near Concrete, would reduce the Skagit River peak by about 28,000 c.f.s.

20. For the same Skagit River peak reduction as would be gained with 62,000 acre-feet of storage, additional storage at the Upper Baker project would be required to reduce the duration of flood stage. If Upper Baker Reservoir inflow were stored until the Skagit River peak at Concrete drops to 90,000 c.f.s., 95,000 acre-feet of storage, or about 1 day more of impoundment, would be required.

21. Table E-1 represents Upper Baker storage requirement based on average expectations of Baker River runoff contributing to selected hypothetical Skagit River flood events.

TABLE E-1
UPPER BAKER AVERAGE STORAGE REQUIREMENTS

Regulation	50-Year (acre-feet)	100-Year (acre-feet)	200-Year (acre-feet)
Store until Skagit River at Concrete peaks	47,000	62,000	78,000
Store until Skagit River at Concrete drops below 90,000 c.f.s.	73,000	95,000	120,000

22. A selection of Baker project storage based upon average Baker River contribution to Skagit River flows would assure adequate protection to the lower Skagit for only 50 percent of the design floods, as the Baker component could be expected to be greater than average 50 percent of the time. In order to make certain that essentially the full range of possible Baker River runoffs contributing to a 100-year Skagit River flood are controlled, storage of 74,000 acre-feet would be required. This amount of storage would enable Baker River discharges to be controlled for maximum Skagit River peak reduction at Concrete with stored floodwaters released from Baker Lake as soon as possible after the Skagit has peaked. If Baker River runoff were stored until the Skagit River discharge at Concrete dropped below 90,000 c.f.s., a volume of 119,000 acre-feet would be needed at the Upper Baker project. Seventy-four thousand (74,000) acre-feet of storage space in Baker Lake has been selected in the recommended plan for the reason that it is the optimum storage volume in terms of reducing Baker River's contribution to major Skagit River flood peaks.

23. The average storage requirements are computed from historical streamflow records. To account for the variability of Baker River streamflow when establishing storage requirements, a variable component of streamflow is added to the average determination in the amount of two standard deviations. This procedure accounts for 95 percent of the range of Baker River flows. Recommended storage requirement of 74,000 acre-feet is based on this procedure to cover all flow reasonably expected from Baker River during a 100-year Skagit River discharge near Concrete. Similarly the total storage required to control the Baker contribution to the Skagit River 50- and 200-year floods would be 56,000 acre-feet and 93,000 acre-feet, respectively. The refillability of Baker Lake would not be significantly affected by increasing required storage evacuation for flood control to 74,000 acre-feet. Inflow to Baker Lake during the months of March through June exceeds 450,000 acre-feet in 90 percent of the years, providing good assurance that the reservoir can be refilled from spring snowmelt runoff.

Regulated Flood Frequencies

24. The frequency curves, reflecting the maximum annual regulated peak discharges based on additional flood control storage at the Upper Baker project, were derived utilizing unregulated frequency curves for Concrete, Sedro Woolley, and Mount Vernon (see plates C-16, -17 and -18). These curves, while unregulated in the sense they do not reflect Upper Baker project, do take into account Ross Reservoir operation. The effect of regulation by Baker project was added to the previously drawn curves to indicate the most probable nature of the flood distribution. Curves were derived by adding the Baker River component with and without regulation to the 100-year hypothetical hydrograph on the Skagit River near Concrete. This hydrograph was then routed downstream past Sedro Woolley to obtain the effects of regulation. Streamflow relationships were also established for the 50- and 200-year floods.

25. The Upper Baker project, operated on the basis of 74,000 acre-feet of total storage space in combination with Ross Reservoir and its present regulation schedule, could reduce the 100-year flood peak at Concrete from 265,000 to 237,000 c.f.s. The 100-year discharge near Mount Vernon would be reduced from 220,000 to 202,000 c.f.s., or a net reduction of 18,000 c.f.s. These discharges for Mount Vernon include a portion of the Skagit River overflow into the Samish River basin and then into Padilla Bay. Existing levees separating the Skagit and Samish basins would, under present-day

conditions, be overtopped when the Skagit River discharge reaches approximately 150,000 c.f.s. between Sedro Woolley and Burlington. Below the point of Samish basin overflow, the discharge in the main river channel would remain relatively constant, even while the discharge just upstream of the basin overflow continued to increase beyond 150,000 c.f.s. Samish basin overflows would cover the Samish flood plain enroute to Padilla Bay.

Spring Flooding

26. Flood control during the spring runoff was given some consideration during the study even though this is not provided for in the existing Federal Power Commission license for Upper Baker project. Spring floods resulting from snowmelt runoff were examined for the Baker and Skagit Rivers. Separate streamflow relationships were established for snowmelt floods. Preliminary analysis showed that 90,000 c.f.s. discharge, Skagit River at Concrete, is exceeded on the average during the spring runoff about once every 16 years. The 100-year spring flood peak at Concrete is estimated at 108,000 c.f.s., or about 40 percent of the winter rain flood peak. Baker River contributes about 10 percent of the combined discharge of the 100-year spring flood at Concrete. Storing of Baker runoff during the spring would only reduce the peak of the 100-year event by about 5,000 c.f.s. with less than 10,000 acre-feet of storage required to accomplish this at the project.

27. Because of the relatively minimal impact the Upper Baker project could have on the spring floods no detailed study or economic evaluation were undertaken on this possible future change in operation. Also, operation of Upper Baker project for control of spring floods would require approval by the Federal Power Commission and a change in the project's license. Normal project operation in the interest of hydroelectric power generation provides for drawdown in anticipation of the spring runoff, based on forecasts. This procedure is expected to continue, thereby incidentally providing flood control storage capability during the spring.

Project Operation

28. The Upper Baker project would be operated during the winter flood season in accordance with an agreement reached between the U.S. Army Corps of Engineers, and the Puget Sound Power and Light Company (Puget Power). The project reservoir would be drawn down in accordance with the 74,000 acre-foot rule curve shown on page 162.

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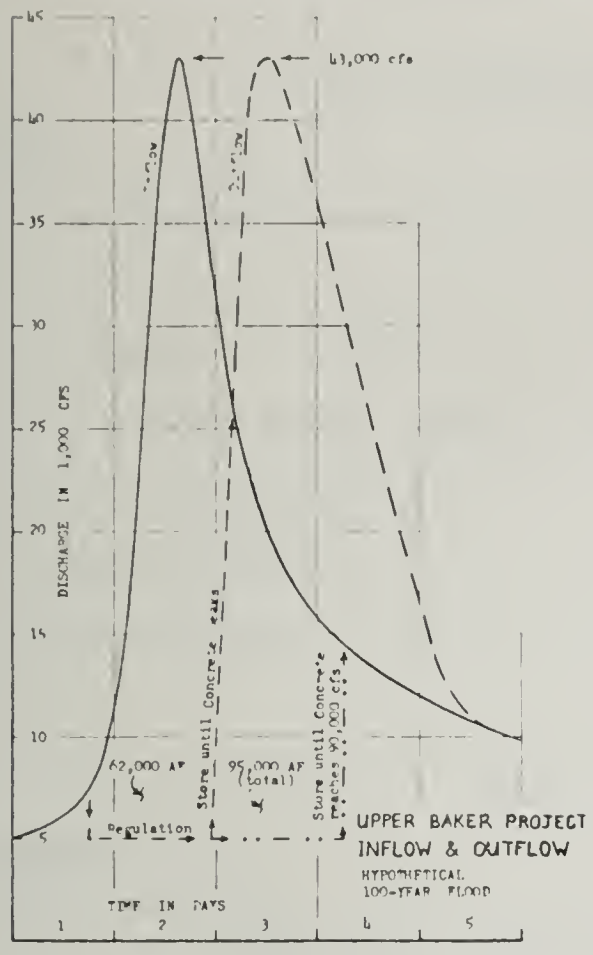
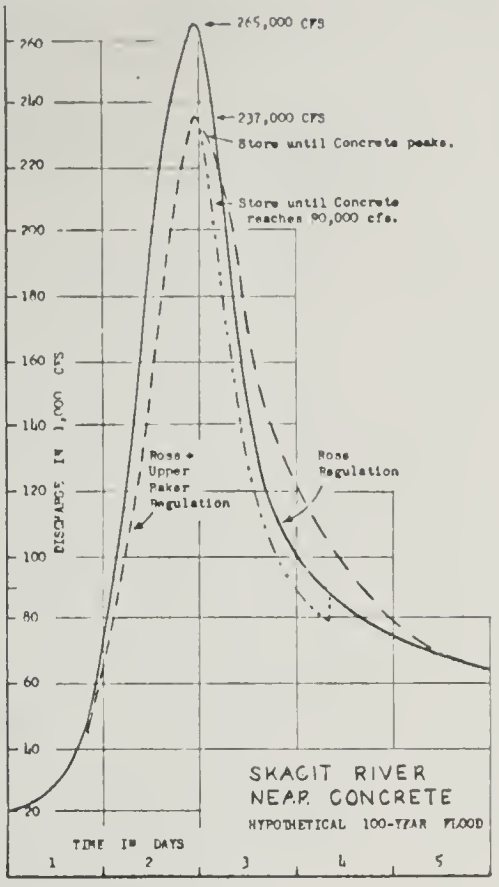
Federal Power Transfer and Reimbursement

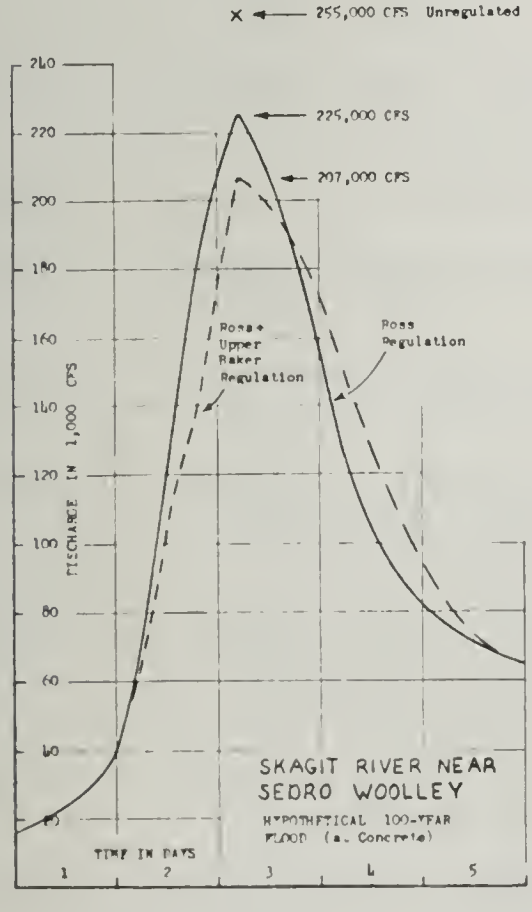
29. Power losses that would occur as a result of lower reservoir elevations during the winter flood season would be computed in accordance with the agreement discussed in paragraph 28. Puget Power would be compensated with power in kind from the Federal system by the Bonneville Power Administration. Bonneville Power has stated that the relatively small amount of power required to compensate Puget Power can be made available from the Federal system without jeopardizing other users.

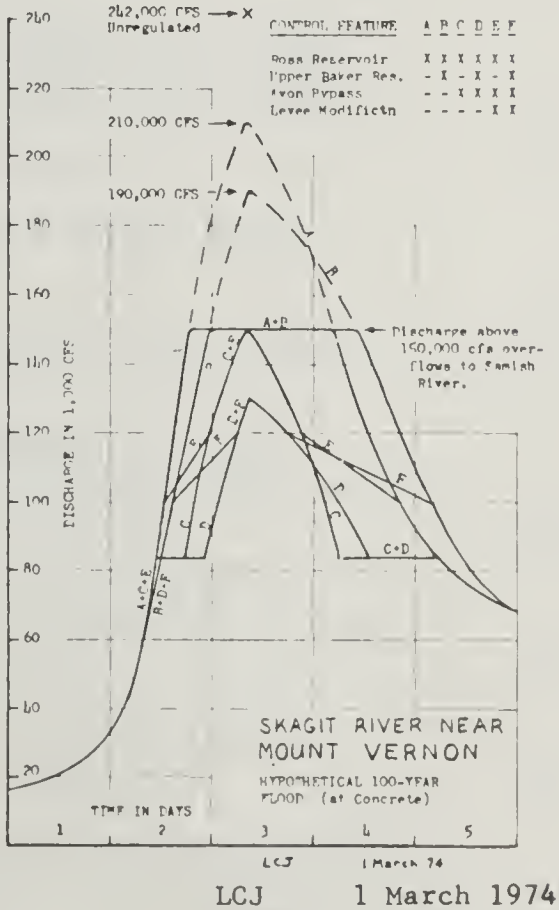
30. The revenues foregone by Bonneville Power as a result of the power transfer would be considered a nonreimbursable Federal flood control cost. The Corps' annual obligation to Bonneville Power can be effected by an offsetting reduction in charges to power at one of the Corps' projects in the Federal Columbia River Power System for which Bonneville Power is the marketing agency. It is proposed that the annual credit be made by reduction in the (power) Operation and Maintenance charges at Chief Joseph Dam, Rufus Woods Lake, Washington, project, a hydroelectric power project on the Columbia River constructed and operated by the Seattle District, Corps of Engineers. This would preclude the need for an annual appropriation to the Corps for transfer to Bonneville Power. In this way, Bonneville Power would be fully compensated for revenues foregone in making the power transfer to Puget Power.

UPPER BAKER REGULATION OF SKAGIT R. 100-YR FLOOD









LCJ 1 March 1974
APPENDIX PLATE E-1

ECONOMICS OF RECOMMENDED PLAN

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SECTION F

ECONOMICS OF RECOMMENDED PLAN

Methodology

1. Economic evaluation of the recommended plan was based on a comparison of costs and benefits. Economic costs were primarily the economic value of hydroelectric power lost in the process of operating Upper Baker project for flood control purposes. Allowance was made in the estimate of costs for preparation of a reservoir regulation manual and Corps administrative costs associated with additional flood control direction and power loss evaluations. Also included in the cost estimate was provision for several years of environmental impact monitoring studies. Economic benefits were based on the future flood damage reductions that would be achieved by operation of Upper Baker project as recommended in this report.

2. For the purpose of economic analysis, project year one (the first year in which the additional flood control storage would be available) was assumed to be the year 1977. Engineering studies by Puget Power support the Corps of Engineers assessment that the remaining physical life of the concrete dam and reservoir exceeds 100 years. Accordingly, a 100-year economic life was used in the analysis. An interest rate of 5-7/8 percent applicable to water resource projects was used for discounting future flood prevention benefits.

3. Existing flood damage prevention benefits were derived employing standard Corps of Engineers methods including detailed field assessment of damage potential using computor simulated water-surface profiles associated with given floods. Benefits attributable to a reduction of future flood damages, above existing levels, were evaluated in conformance with EC 1105-2-12 (Evaluation of Economic Benefits For Flood Control and Related Water Resource Planning.) Benefits were based on an analysis of damages under conditions of "with and without" additional flood control at the Upper Baker project. Annual costs were based on the cost of providing equivalent power to replace power production foregone as a result of the change in flood control operation.

4. Maximization of net tangible benefits, another step in the economic analysis, was undertaken to determine the optimum amount of additional flood control storage that should be provided at

the project. Net benefits are maximized when the greatest excess of benefits over costs occurs. This is the point where the last increment in flood control storage space has an incremental cost equal to incremental benefits, and any further increase in size would not be incrementally economically justified. Maximization does not reflect intangible values as they are not quantifiable in terms of dollars.

Costs

5. The economic evaluation of annual power losses resulting from the recommended plan was based on the cost of providing replacement power from new alternative powerplants, similar to the evaluation of power benefits attributable to new hydroelectric projects. Also included in the average annual cost was allowance for administration of the additional flood control at Upper Baker project, the cost of preparing a reservoir regulation manual and 5 years of follow-up environmental impact monitoring. An interest rate of 5-7/8 percent was used in discounting future costs and converting these costs to an average annual equivalent cost.

6. Puget Power performed the power loss evaluation studies based on flood control rule curves provided by the Seattle District, Corps of Engineers. Power loss evaluation computations performed by Puget Power were reviewed and checked by the Corps of Engineers and the Bonneville Power Administration to insure that the computed average annual losses were reasonable. Puget Power analyzed power losses (capacity and enery) associated with three cases of additional storage by comparing the power that could be produced if the existing (16,000 acre-foot) flood control rule curve were followed with the power production possible under rule curves developed for each of the three cases (See appendix 2, Puget Power letter dated 3 May 1974). The average annual value of lost power was based on Federal Power Commission established unit costs for alternative power production plants. For this proposal, values reflected a 75 percent annual capacity factor nuclear power project, 75 percent public (non-Federal) financed at 7-1/4 percent interest rate and 25 percent private financed at 10 percent interest rate. Table F-1 shows the evaluation for the recommended plan (58,000 acre-feet additional storage).

TABLE F-1
Average Annual Costs
58,000 Acre-feet Additional Flood Control Storage
Upper Baker Project

Capacity:	(6,300 kw maximum quantity) x ($64.29 per kw/yr) =	$405,000
Energy:	(1,117 kw x 8,760 hours)($.00173/kw-hr) =	17,000
Total value of power lost:		422,000
Flood control administration costs: 1/		12,000
Total average annual costs:		$434,000

1/Includes $21,000 for negotiation and preparation of power loss evaluation agreement and preparation of reservoir regulation manual during first year of additional flood control operation; $5,000 annually for environmental impact monitoring studies during first 5 years of change in flood control operation; and $9,000 annually for increased administrative costs associated with recommended plan.

7. Bonneville Power Administration (see appendix 2, Bonneville Power letter dated 11 April 1975) in reviewing the power loss evaluation of Puget Power computed the value of revenue foregone by Bonneville Power in making available replacement power as follows:

Demand Charge	=	$32,950
Transformation Charge	=	3,140
Energy Charge	=	19,772
Total		$55,862
Rounded		$56,000

8. The above was based on power rates applicable in April 1975 with the Corps of Engineers viewed as a preference customer. Actual cost to the Federal Government in providing replacement power to Puget Power should be less than the amounts shown in this report as the power loss estimates used in the economic analysis are conservative.

9. Power losses were computed on the assumption that Puget Power, in the absence of the recommended plan, would seek to hold Baker Lake as high as possible in order retain maximum capacity at the project. In effect, the drawdown and subsequent reservoir levels would follow the 16,000 acre-foot rule curve. As can be seen from examining plates F-1 through F-5 (historical operation of the Upper Baker project over the period 1969-1973.) Puget Power has not

operated this way in the recent past. Puget Power would be expected to operate in the foreseeable future as they have in the recent past such that, in the absence of additional flood control regulation as recommended in this report, Baker Lake would be drawn substantially below the 16,000 acre-foot rule curve each year. The assumption of a higher pool was used in the economic analysis as this provided the most conservative (highest) estimate of power losses. Also, Puget Power is in fact expected to hold Baker Lake at higher elevations in the long-term future as this project is used more for peaking purposes when additional Pacific Northwest thermoplants are placed in operation. Actual power losses would be computed as they occur and would be based on daily power loads, prevailing hydrologic conditions and physical plant capability.

10. The same assumption of Baker Lake levels following the flood control rule curve was used in computing energy and capacity output for "with" recommended plan conditions. Differences between the base condition (16,000 acre-feet) and alternative increases in flood control storage space were taken as power losses.

Benefits

Flood Damage Reduction Benefits

11. The derivation of flood damage reduction benefits, attributable to added flood control storage at the Upper Baker project, is presented in following paragraphs.

Extent and Character of the Flood Plain

12. The portion of the Skagit River flood plain considered in this report is located west or downstream from the mouth of the Baker River near the town of Concrete. This part of the flood plain would be affected by the additional flood storage at the Upper Baker project. The 32 miles of river valley west of Baker River to Sedro Woolley is narrow and composed primarily of farmlands and wooded areas. Communities subject to flooding and their 1970 populations within this river reach are Grassmere 1/, Cape Horn 1/, Hamilton (196), Lyman (320) and part of Sedro Woolley (4,600).

1/Unincorporated and less than 1,000 population.

West of Sedro Woolley the flood plain forms a large alluvial fan with an east-west width of about 11 miles and north-south width of 19 miles. Communities in this part of the flood plain include Burlington (3,140), Mount Vernon (3,300), Conway 1/, La Conner (640), Edison 1/ and Avon 1/. The 100-year flood plain west of Baker River comprises almost 100,000 acres of land. The flood plain lands west of Sedro Woolley are fertile and highly productive. The area is predominately agricultural. Large dairy herds are supported by good pasture and hay, grain, and silage crops. A large portion of the flood plain is devoted to spring-planted crops such as sweet corn, peas, bulbs, berries and other truck garden use categories. Table F-2 presents acreage for various urban and rural land use categories.

1/Unincorporated and less than 1,000 population.

TABLE F-2
Flood Damages and Land Use Summary For Floods
Used to Establish Stage-Damage Relationship

Category	10-Year Flood (130,000 c.f.s.) 4/ Acres	10-Year Flood (130,000 c.f.s.) 4/ Damages ($1,000)	100-Year Flood (220,000 c.f.s.) 4/ Acres	100-Year Flood (220,000 c.f.s.) 4/ Damages ($1,000)
Residential	1,000	$4,270	1,600	$11,220
Commercial/ Industrial 1/	750	4,133	1,050	15,205
Roads & Public Facilities	2,400	398	3,200	828
Agricultural	71,800	6,016	87,200	10,422
Other	4,300 2/	208 3/	6,400 2/	422 3/
Total	80,250	$15,025	99,450	$38,097

1/Includes Railroads.

2/Vacant land (Brush & Woods)

3/Includes emergency aid, evacuation, debris clearance and is not directly comparable to a particular land use.

4/Skagit River gage, near Mount Vernon.

Value of Land Improvements in the Flood Plain

13. The flood plain contains thousands of structures and includes a full range of farm, residential, commercial, and industrial buildings with connecting roads and utilities. An estimate of the total valuation of lands and improvements in the flood plain was developed from a sample area of the flood plain. The value of private land, improvements, and personal property in the flood plain area was estimated to be approximately $217,000,000 under 1974 prices and conditions. The value of public facilities and land in the flood plain was estimated to be $7.8 million.

Ownership of Flood Plain Lands

14. The flood plain that would be affected by additional flood control storage at the Upper Baker project contains almost 100,000 acres. Based on a review of the county assessor's records and other information supplies by the assessor, an approximate ownership distribution was determined. Ownership distribution was determined to be sufficiently widespread so that no windfall benefits would accrue to any individual owner.

DISTRIBUTION OF OWNERSHIPS

Acres	Number of Owners	Percent of Total
Less than 1	1,600	44.2
1-4	504	13.9
5-9	184	5.1
10-19	356	9.8
20-39	388	10.7
40-59	168	4.7
60-90	212	5.9
90-400	180	5.0
Over 400	26	0.7
Total	3,618	100.0

Existing Flood Protection

15. Runoff upstream from the proposed project originates in the Cascade Mountains in the United States and Canada. Ross Dam reservoir on the Skagit River provides 120,000 acre-feet of flood storage. Between the towns of Concrete and Sedro Woolley low levees protect several rural areas and the town of Hamilton from minor floods. The flood plain west of Burlington is protected from the more frequent lower floods by levees. Protection provided by levees ranges from 84,000 to 130,000 c.f.s. In terms of average recurrence intervals, protection ranges from once in 3 years to about once in 10 years. In addition, dikes along Skagit Bay protect adjacent agricultural lands against tidal flooding.

Historical Floods and Damages

16. The flood plain of the Skagit River has been flooded many times in the past. The most recent flood causing extensive damage occurred in February 1951. Heavy damage was done to crops, land, buildings, roads, railroads, and other improvements. Some of the larger historical floods and the damages which would be caused by their recurrence under 1973 prices and conditions are presented in table F-3.

TABLE F-3
Historical Skagit River Floods

Date	Discharge 1/ (c.f.s.)	Damages 2/ ($)
1815	400,000	-
1856	300,000	-
Nov 16, 1896	185,000	22,550,000
Nov 19, 1897	190,000	22,850,000
Nov 16, 1906	180,000	20,350,000
Nov 30, 1909	220,000	29,500,000
Dec 30, 1917	195,000	23,850,000
Dec 13, 1921	210,000	27,050,000
Feb 11, 1951	150,000	18,630,000

1/Observed discharges near Sedro Woolley, Washington.

2/Estimated damages based on 1973 prices and conditions of development and regulated discharges operation.

Survey of Flood Damages

17. During 1973, a flood damage appraisal was made based on the inundation expected for floods having 10- (130,000 c.f.s.) and 100-year (220,000 c.f.s.) average recurrence intervals. Water surface profiles for these respective floods were used in field studies with the varying degree of present flood protection afforded by existing levees taken into account. Present land use, including crop patterns, desity of improvements, and value of improvements subject to damage, were evaluated. Entire residential and commercial areas subject to flooding were evaluated separately. Agricultural lands were disaggregated into subareas for analysis. Damages were then aggregated and presented in this report as a total for rural portions of the flood plain. Crops are fairly homogeneous throughout the flood plain and damages were estimated by applying unit values of damages per acre to the acreage of the corresponding crop. Damage to each large commercial and public facility was appraised independently. Value of damages for other items such as roads, railroads, fences, and some utilities were appraised on the basis of miles inundated. The appraisal process for the determination of emergency aid utilized information on historical expenditures and the severity and duration of floods. These expenditures included costs to perform emergency levee or dike repairs at the flood channel, flood fight and evacuation costs, and the cost of additional police and fire department activities. If a flood having a 10-year recurrence interval had occurred in 1973, an estimated $15,025,000 in damages would have resulted. A 100-year flood would have produced $38,097,000 in damages. Table F-2 shows the value of flood damages and the corresponding acreage by category for these two flood events.

Types of Flood Damages

18. Flood losses or damages were designated by category of damage. The following tangible damages were considered: (1) Physical damages caused by inundation; (2) emergency losses or costs incurred in fighting or in anticipation of the flood; and (3) business or other financial losses resulting from decreased production, profits

and wages, and increased cost of normal operations and living. Tangible damages were determined for the following categories or types of flood losses.

a. Urban Flood Losses.

(1) Residential. Residential losses include inundation losses to nonfarm residences and contents, appurtenant buildings, and grounds.

(2) Commercial. Commercial damages include losses to all properties used in wholesale or retail business, trade, servicing, or entertainment as distinguished from other properties used in industry, public administration, utility production or service, and transportation. Physical damages to commercial property and facilities include damages to land, buildings, equipment, supplies, merchandise, and other items used in the conduct of business. Loss of business sustained by commercial activities as a consequence of floods is the result of loss of net profits to owner or operator of a business. Sales and profits postponed to a later date were not considered a flood loss. Loss of wages to employees of a commercial establishment were considered when such losses were not compensated for by employment in emergency activities during flood and rehabilitation periods.

(3) Other. Other urban damages include some industrial damages, damage to utilities, public facilities, roads, streets, and bridges. Damages to public facilities include structures, equipment, and furnishings owned or operated by Federal, state, county, or local governments. Utility damages include losses to electric, water, and telephone plants, transmission lines, and other similar facilities. Also included under this category is the cost of emergency aid which covers expenditures essential for the preservation of life and property.

b. Rural Flood Losses.

(1) Agricultural. Agricultural damages include losses and destruction of growing crops and land, losses to farm dwellings, barns, and other appurtenant buildings and their contents. Losses to equipment, stored crops and feed, livestock, fences, lands, bridges, private levees, bank protection, and other farm facilities were considered. Siltation, loss of soil fertility, and cost of removal of debris and weed seed were also a part of tangible damages estimated. Livestock damages include loss or injury to cattle used in beef and milk production.

(2) Emergency aid. The cost of emergency aid includes expenditures essential for the preservation of life and property, such as clearance of debris and wreckage, emergency repair, or

temporary replacement of private and public facilities, evacuation assistance, Federal aid for flood fighting, flood emergency preparation, rescue operations, police protection, and repair and restoration of damaged flood control works. Also included is Federal assistance to states and local governments to accomplish channel clearing, debris removal, and other emergency channel work on unimproved streams. Aid and relief activities include two general categories: (1) That furnished to individuals and family units directly affected by a flood, and (2) that furnished for emergency rehabilitation of communities and cities. Aid to individuals and families is generally furnished by public and private social and welfare groups and by national disaster relief organizations such as the Red Cross.

(3) Other. Included in this category are damage to utilities, public facilities, roads, streets, bridges, nonfarm vehicles, and mobile equipment. Damages to public facilities include structures, equipment, and furnishings owned or operated by Federal, state, county, or local governments. Public business losses include losses in sales or revenue, loss of wages, and increased cost of normal operations. Utility damages include losses to electric, water, and telephone plants, transmission lines, and other similar facilities. Nonfarm vehicles damaged include buses, trucks, autos, and mobile equipment not related to farm use. Monetary losses due to highway traffic delays are included in this category. Also included in "other" rural damages are minor amounts of damage to residential, commercial, and industrial contents and structures.

Method of Evaluating Agricultural Flood Damages

19. The agricultural flood damage category in this report includes damage to pasture, crops, farm buildings, roads, fences, and other improvements associated with farming. Agricultural land use in the 10- and 100-year flood plains were classified and mapped. The total acreage of each land use was then determined. Only winter floods will be partially controlled by the proposed additional flood storage at the Upper Baker project. Therefore, only pasture and crops which are in the ground during the winter were evaluated for flood damage. Crops include winter wheat, bulbs, berries, hay, and grass for seed. A large portion of the flood plain is planted in peas, corn, wheat, and other truck garden vegetables in the spring and lies fallow during the winter. Unit damages are based on information obtained from Federal and county agricultural agencies and farmers who are located in the flood plain of the Skagit River.

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a. Hay and Pasture. Loss due to flooding of hay and pasture by winter floods results from a reduction of support capability and cost of reseeding to replace grasses. Only part of the pasture grasses will be killed by drowning, scour, and deposition of sand and gravel.

Winter Flood Damage Per Acre.

Loss of support capability of 10 to 15 percent of the acreage for 3 months	--	$4.50 to $6.75
Cost to reseed 0.10 to 0.15 acre	--	5.10 to 7.65
Totals	--	$9.60 to $14.40

b. Winter Wheat. Winter wheat is destroyed by winter flooding. The loss is the cost of cultivating and planting incurred prior to the flood. The loss of net profit is not considered, as a new crop would be planted in the same area in the spring.

Winter Flood Damage Per Acre.

Expended cultivating and planting costs	--	$30

c. Bulbs. Most of flower bulbs which are in the ground during a winter flood are destroyed by drowning. Losses are the costs of production up to the time of the flood, value of planted bulbs, and the loss of net profit that would have been realized.

Winter Flood Damage Per Acre.

Production costs, value of bulbs, and loss of net profit	--	$1,160

d. Berries. The two main berry varieties grown in the flood plain are raspberries and strawberries. During the winter flood period, the berry vines are in a dormant condition and are not ordinarily drowned. Part of the acreage is damaged due to scouring of the soil around the plant roots, the deposition of sand, gravel and debris on the vines and roots, and the tearing out of vines by flood currents. The loss is the cost of aerating the soil by tilling around surviving plants, replacement of lost vines, and the loss of net profit from the portion of the vines lost.

(1) Raspberries.

Winter Flood Damage Per Acre.

Till soil, replace lost vines, and loss of net profit	--	$280

(2) Strawberries.

Winter Flood Damage Per Acre.

Till soil, replace lost vines, and loss of net profit	--	$260

e. Grass for Seed. About 15 percent of the grass for seed crop area inundated will be lost when flooded. The damage results from ponding of water, scour, and deposition of silt, sand, gravel and debris. The loss is the cost to re-establish the grass and loss of net profit.

Winter Flood Damage Per Acre.

Re-establishment of grass and loss of net profit	--	$35

Derivation of Average Annual Damages

20. The average annual value of flood damages was derived graphically in the following manner:

a. Discharge-Frequency Relationship. Skagit River exceedence frequency discharge curves prepared for the gage near Mount Vernon, 1/ reflecting "with and without" additional flood control storage conditions, were used to derive estimates of average annual flood damages. These curves (see plate C-18) are discussed in Section C, Problems and Needs, and Section E, The Recommended Plan.

b. Discharge-Damage Relationship. A discharge for point of zero damage for areas to be protected by a proposed project was determined from available information on streambank full capacity and date on historical floods. Discharge-damage curves for total damage and for each category of damage, such as residential, agricultural, and commercial, were prepared by plotting damages from the 10- and 100-year frequency floods, adjusted to 1973 conditions and prices against the corresponding flood discharges measured at the gage near Mount Vernon.

c. Damage-Frequency Relationship. Curves showing damage-frequency relationship were prepared by graphical correlation by quadrant plotting of the discharge-damage and discharge-frequency curves for existing conditions.

1/Skagit River discharge below the town of Concrete (confluence with the Baker River) is not greatly affected by local inflow.

d. Average Annual Damage. The area above the damage-frequency curve, converted to its equivalent value in dollars, is the average annual damage in terms of 1973 prices and conditions.

Flood Damages Under Existing Conditions and Prices

21. Plates F-6 and F-7, "Flood Damage Relationship Curves," show schematically the curves from which recurring flood damages were derived. The curves are based on 1973 prices and conditions. However, the data presented in the following text and tables reflects updating by indices to 1974 prices and base conditions. Also the assumption was made that additional flood control storage would be provided at the Upper Baker project before any other structural flood control improvements are made in the Skagit basin. This treatment of additional Baker Lake flood control as "first added" is considered to be valid on the basis that merely an operation change is required to implement the recommended plan whereas a good deal of additional studies are required before any new flood control project is undertaken in the basin. The existing average annual flood damages for the rural portion of the flood plain are $1,976,000 and for the urban portion, $2,270,000. Table F-4 details total annual damage by major damage category.

TABLE F-4

AVERAGE ANNUAL DAMAGES
(1974 Prices and Conditions)

Category		Average Annual Damages
Rural:	Emergency Aid	$ 42,000
	Other	91,000
	Agricultural	1,843,000
	Subtotal	$1,976,000
Urban:	Other	$ 86,000
	Residential	1,027,000
	Commercial	1,157,000
	Subtotal	$2,270,000
Total		$4,246,000

Land Value Check

22. Reliability of estimated agricultural flood prevention benefits can be partially checked by comparing the difference in the value of flood plain land protected by the proposed project with the value of

flood-prone land which would remain unprotected. Market value of land is based on estimated net income potential of the land. Since flood damage expense reduces net income, the value of flood-prone land should be less reflecting reduced net earning potential.

23. This project would not completely eliminate flooding in agricultural areas. In some areas only a slight reduction in flooding frequency would be realized and in other areas only the depth of water would be reduced. Land values are not sensitive to minor changes in monetary risk. Consequently, different market values are not available for comparative purposes. The minimal difference in the value of land with as compared to without the project can be estimated by comparing average annual agricultural flood reduction benefits of $119,000 1/ to the 65,750 acres 2/ in the 100-year flood plain. This represents only $1.81 per acre in annual increased net earning potential.

Future Growth in the Flood Plain

(1) General.

24. Determination of growth factors to represent the increase in damageable items in the flood plain, assuming no additional flood protection, was based on selection of pertinent economic indicators and correlating them with the economic environment in the flood plain. The purpose of this paragraph is to: (a) project the growth of the flood plain area to determine increase in future development and associated changes in land use in the overall rural and urban areas, and to (b) estimate the extent to which these changes would affect the development and use of the specific flood plain area (without flood protection). Indicators for the rural and urban areas of the flood plain were derived after extensive office studies, field surveys, and discussions with local planners, county public officials, and city officials. Consideration was given to the effects of 100-year flood plain zoning provided under the Washington State Flood Control Zone Act of 1935 and the U.S. Department of Housing and Urban Development's National Flood Insurance Program. From the selection of proper indicators, projected annual growth rates were derived and translated into average annual growth factors, adjusted to allow discounting of future flood prevention benefits at 5-7/8 percent. Future conditions for the urban categories of residential and other were analyzed. No increases were assumed for the commercial category of urban damages due to flood plain management practices. Rural damage categories included agricultural, other, and emergency aid.

1/Damages to crops and land only.

2/This is less than the total agricultural acreage shown in table F-1 as it includes only cropland and not additional land usually regarded as agricultural.

(2) Rural Area.

(a) Agricultural. Agricultural damages include losses to crops, soil capability, and capital investments such as buildings, contents, equipment, fences, and roads. Based upon the field-appraised value of average annual agricultural damages, the losses were segregated into two parts for analysis: (1) 34 percent accruing to crop and soil losses, and (2) 66 percent to capitol investments. Crop and soil losses include scour and erosion, deposition of silt and gravel, weed seed damage, loss or leaching of plant food, water damage, and cleanup costs. Existing crops in the flood plain that would be affected by the project are hay, bulbs, raspberries, strawberries, seed grass, winter wheat, and winter barley. Flower bulb damage constitutes over half of the monetary crop loss. Data on growth in output per acre for bulb crops were not available and historic productivity data on the other minor crops in the flood plain were not felt to be representative of the future growth in damages that would reasonably be expected to occur. Agricultural Statistics, published by the U.S. Department of Agriculture, shows that nationally, productivity increases for all crops have grown at an annual rate of 1-1/2 percent between 1954 and 1970. To be conservative, this figure was reduced by 1 percent, reflecting slow productivity advances in the bulb industry suggested by the county Agricultural Extension Agent and to account for agricultural land lost to encroaching residential and commercial uses. The resultant growth rate of 0.5 percent annually was used to project future growth in output per acre and growth in damages to capital investments to 2027. No growth was assumed between 2027 and 2077. The growth factors are shown in table F-5.

(b) Other and Emergency Aid. Other rural flood damages consist of repair and replacement of roads, bridges, utilities, and public facilities; minor damages to residential, commercial, and industrial establishments; and damage to railroad facilities. Emergency aid includes expenditures incurred for care of refugees, cost of material, and operation of equipment; and labor involved in emergency operations, floodfighting, and repair. Since these categories of expenditures or damages are closely related to the number of people in the flood plain, it has been assumed that future growth would increase proportionately with population growth. Between 1940 and 1970, population grew at an average annual rate of 2.2 percent in Burlington, 2.4 percent in Mount Vernon (located in flood plain), and 1.1 percent in Skagit County as a whole. The Skagit Regional Planning Council has used a 1.0 percent average annual growth rate for their county high range level projections to the year 2000. Population growth in the flood plain was estimated to increase at the rate of Skagit County's historic population growth of 1.1 percent annually to year 2027. No growth was assumed thereafter. Growth factors for this rate can again be found on table F-5.

(3) Urban Area.

(a) Residential. Average annual residential damages include inundation losses to nonfarm residences and contents, associated structures, and other related improvements. The structures are generally in good condition and of average quality construction. Residential development in the urban portion of the flood plain has expanded more rapidly than in the rural portion. Based on existing State of Washington flood plain zoning and U.S. Department of Housing and Urban Development requirements and the stated and demonstrated intentions of Skagit County for strict enforcement of these regulations, growth in flood damages associated with structures should be insignificant or zero. Consequently, no growth was assumed for damages to structures. Existing household contents, however, would be replaced with higher value household durables. This new investment would tend to increase future flood damages. The 1974 appraisal found that content damages were about half of all residential damages. Growth in the value of contents was measured by growth in per capita income. Relevance of this indicator has been supported nationally in studies by Resources for the Future, Inc. (RFF). A constant ratio between income and household expenditures was found to hold during the period from 1936 to 1980. This trend was projected by RFF to continue to year 2000. Per capita income growth in the flood plain was assumed to be the same as that projected by the U.S. Departments of Commerce and Agriculture (OBERS - Series E) for the Puget Sound subarea 1714--an average of 2.5 percent annually to 2027. No growth was taken for the second 50-year period, 2027 to 2077. When increased, total content value was limited to 75 percent of the structure value. Existing ratio of content value to structure value is 50 percent. This constraint limited projected growth in average annual residential content damage. Based on project year one at 1977 and a 100-year period of analysis for major long-term urban protection and main-line levees, table F-5 displays the average annual growth rates and growth factors.

(b) Other. Flood damages in this category consist of expenditures for the repair and replacement of roads, bridges, utilities, and public facilities; damages to industrial facilities and railroads; and emergency aid. Growth in these damages or expenditures is related to flood plain population increases which have previously been estimated at 1.1 percent annually to 2027. No growth was taken between 2027 and 2077. Growth factors can be found on table F-5.

TABLE F-5

ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT
GROWTH RATES AND FACTORS

Category	Average Annual Growth Rate		Growth Factor	Average Annual Equivalent Discount Factor 100 Yrs	
	1974 - 2027	2027 - 2077	To 1977	Actual 1/	Upper Limit
Rural:					
Emergency Aid	1.1	0	1.03	1.22	
Other	1.1	0	1.03	1.22	
Agriculture	0.5	0	1.02	1.09	
Urban:					
Other	1.1	0	1.03	1.22	
Residential:					
Content	2.5	0	1.08	1.62	1.50 2/
Structure	0	0	-	-	
Commercial	0	0	-	-	

1/Equivalent average annual factor discounted at 5-7/8 percent.

2/ $\frac{.75 \text{ (content value as percent of structure value - upper limit)}}{.50 \text{ (existing content value as a percent of structure value)}}$ = 1.50 (Growth Factor)

Rev. July 75

Future Growth of Flood Damages

25. With existing flood protection and more intensive economic development in the flood plain, flood damages may be expected to increase in the future. A 100-year study period has been projected for the Skagit River flood plain. The proposed project is anticipated to be operable by 1977 and has been evaluated for a 100-year period. Table F-6 shows total average annual equivalent damages including growth that could occur during these time periods.

TABLE F-6

GROWTH IN AVERAGE ANNUAL DAMAGES WITHOUT
ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT
(1974 Prices and Future Conditions)

Category	Existing Conditions 1974	Project Year One 1977	100 Years 1977 - 2077
Rural:			
Emergency Aid	$42,000	$43,000	$52,000
Other	91,000	94,000	115,000
Agricultural	1,843,000	1,880,000	2,049,000
Subtotal	$1,976,000	$2,017,000	$2,216,000
Urban:			
Other	$86,000	$89,000	$109,000
Residential:	1,027,000	1,068,000	1,284,000
Contents	(514,000)	(555,000)	(771,000) 1/
Structure & Land	(513,000)	(513,000)	(513,000)
Commercial	1,157,000	1,157,000	1,157,000
Subtotal	$2,270,000	$2,314,000	$2,550,000
Total	$4,246,000	$4,331,000	$4,766,000

1/Growth limited to factor of 1.50 ($514,000 x 1.50 = $771,000)

Project Accomplishment-Existing Conditions

26. Plates F-6 and F-7, "Flood Damage Relationship Curves" graphically show the relationship between floodflows and chance of occurrence for both preproject and postproject conditions based on 1973 prices and conditions. If the project were in operation in 1974, an estimated $1,004,000 in average annual damages could have been prevented in rural and urban areas that would be partially protected. The annual residual damages or damages not prevented would be about $3,242,000. Table F-7 shows existing average annual damages, residual damages, and flood prevention benefits at 1974 price levels.

TABLE F-7

AVERAGE ANNUAL DAMAGES, WITH AND WITHOUT
ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT
(1974 Prices and Conditions)

Category	Existing Annual Damage (1974)	Residual Annual Damage	Annual Flood Reduction Benefits
Rural:			
Emergency Aid	$42,000	$34,000	$8,000
Other	91,000	74,000	17,000
Agricultural	1,843,000	1,492,000	351,000
Subtotal	$1,976,000	$1,600,000	$376,000
Urban:			
Other	$86,000	$63,000	$23,000
Residential	1,027,000	742,000	285,000
Commercial	1,157,000	837,000	320,000
Subtotal	$2,270,000	$1,642,000	$628,000
TOTAL	$4,246,000	$3,242,000	$1,004,000

Remaining Flood Damages

27. The recommended plan would not completely eliminate flooding below the mouth of the Baker River. In some urban areas, only a small change in flood potential would be realized while in some agricultural areas, flooding would still occur as often as in the past but the depth of water would be reduced. A substantial flood threat would still remain; consequently, no increase in flood plain development and therefore induced damages are anticipated as a result of the plan. While the peak discharge of the 100-year Skagit River flood event under current conditions would be reduced by 18,000 c.f.s. at Mount Vernon, the amount of land area covered by the regulated 100-year flood would not appreciably change from preproject conditions due to the nature of the flood plain itself. State and Federal laws limiting flood plain development would therefore still apply. Residual damages shown in table F-7 are a quantitative measure of those damages which would continue to be incurred on an average annual basis with the project.

Project Justification-Existing Conditions

28. As discussed in the previous paragraph, flood damage reduction benefits based upon 1974 prices and conditions are $1,004,000. Average annual costs over the life of the project are $434,000. The derivation of these annual costs can be found in paragraphs 5 through 10 starting on page F-2. Comparing the annual benefits to the annual costs of providing equivalent power to replace the power lost indicates that the project is economically justified solely on existing flood damage reduction benefits with a benefit-cost ratio of 2.3 to 1.

Inundation Reduction Benefits-Future Conditions

29. Future growth in the flood plain without the project has been previously discussed in this section. It is expected that future growth in benefits will be at the average annual rates displayed in table F-5. Application of these average annual growth factors

indicate that by the first year of project operation (1977) total rural and urban average annual benefits will be $1,024,000. For a 100-year study period (1977-2077), the discounted average annual equivalent benefits are expected to be $1,127,000. Table F-8 shows the benefits by category of damage.

TABLE F-8

AVERAGE ANNUAL INUNDATION REDUCTION BENEFITS
(1974 Prices and Future Conditions)

Category	Present Conditions and Prices	Project Year One 1977	100 Years 1977 - 2077
Rural:			
Emergency Aid	$8,000	$8,000	$10,000
Other	17,000	18,000	22,000
Agricultural	351,000	358,000	390,000
Subtotal	$376,000	$384,000	$422,000
Urban:			
Other	$23,000	$24,000	$29,000
Residential	285,000	296,000	356,000
Contents	(143,000)	(154,000)	(214,000) 1/
Structure & Land	(142,000)	(142,000)	(142,000)
Commercial	320,000	320,000	320,000
Subtotal	$628,000	$640,000	$705,000
TOTAL	$1,004,000	$1,024,000	$1,127,000

1/Growth limited to factor of 1.50 ($143,000 x 1.50 = $214,000)

30. In table F-9, benefits are displayed as undiscounted average annual values for present conditions (1974), the base year (1977) and by subsequent decades following implementation of plan to the year 2077. Growth rates from table F-5 were used to derive undiscounted growth factors which were then applied to current year benefits.

TABLE F-9

UNDISCOUNTED AVERAGE ANNUAL INUNDATION
REDUCTION BENEFITS

(1974 Price Level - in $1,000)

Benefit Category	Present Conditions (1974)	Undiscounted Future Growth					
		1977 1/	1987	1997	2007	2017	2027-2077
Rural:							
Emergency Aid	$8.0	$8.0	$9.0	$10.0	$11.0	$12.0	$14.0
Other	17.0	18.0	20.0	22.0	25.0	28.0	31.0
Agricultural	351.0	356.0	374.0	393.0	413.0	435.0	457.0
Subtotal	$376.0	$382.0	$403.0	$425.0	$449.0	$475.0	$502.0
Urban:							
Other	$23.0	$24.0	$27.0	$30.0	$33.0	$37.0	$41.0
Residential	285.0	296.0	339.0	356.0	356.0	356.0	356.0
Contents	(143.0)	(154.0)	(197.0)	(214.0) 2/	(214.0) 2/	(214.0) 2/	(214.0) 2/
Structures & Land	(142.0)	(142.0)	(142.0)	(142.0)	(142.0)	(142.0)	(142.0)
Commercial	320.0	320.0	320.0	320.0	320.0	320.0	320.0
Subtotal	$628.0	$640.0	$686.0	$706.0	$709.0	$713.0	$717.0
TOTAL	$1,004.0	$1,022.0	$1,089.0	$1,131.0	$1,158.0	$1,188.0	$1,219.0

1/Project Year One
2/Growth limited to factor of 1.50 ($143,000 x 1.50 = $214,000)

Other Benefits

31. Incidental beneficial improvements in average annual sockeye salmon production may result from recommended plan over existing conditions as Baker Lake would be drawn down earlier than has been the practice in the past or expected in the future in the absence of additional flood control storage. (See Section D, Formulating A Plan.) However, neither Federal nor State Fish and Wildlife agencies were able to quantify fishery enhancement benefits. Accordingly, no such benefits are claimed at this time. Follow-up environmental monitoring studies, recommended in this report, may provide a basis for establishing these benefits.

Justification

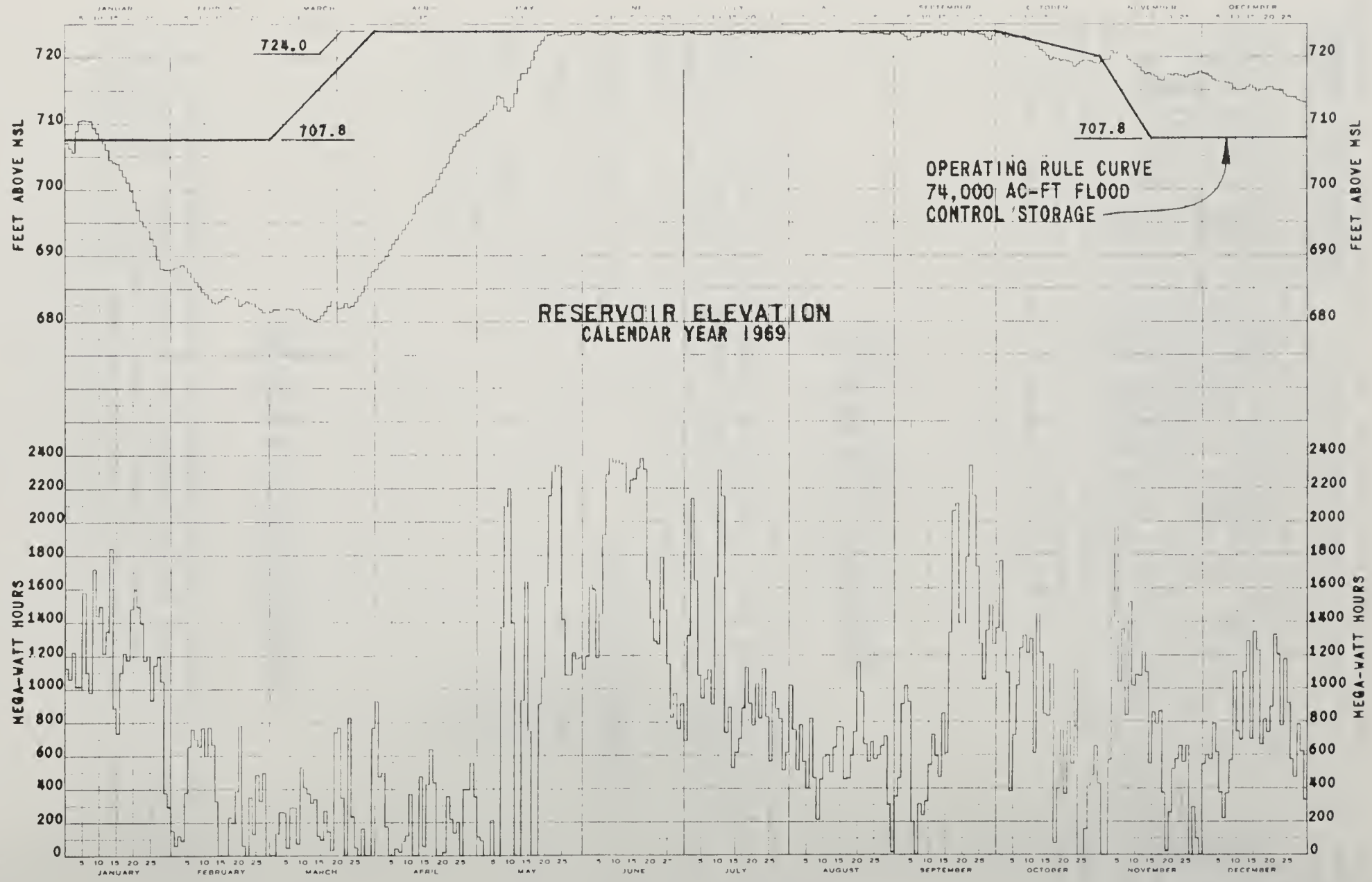
32. A comparison of average annual benefits with average annual costs is shown in the tabulation below for the recommended plan. Although intangible benefits and possibly tangible secondary benefits may accrue to the national economy, only tangible primary benefits are represented in the tabulation.

Average annual benefits	100-year analysis
Inundation reduction	$1,127,000
Average annual costs	$434,000
Benefit/cost ratio	2.6

Maximization

33. As previously mentioned, maximizing net tangible benefits is an economic concept aimed at determining the size of a project, or investment, to the point where the next increment of cost added is greater than the incremental benefit to be gained. Average

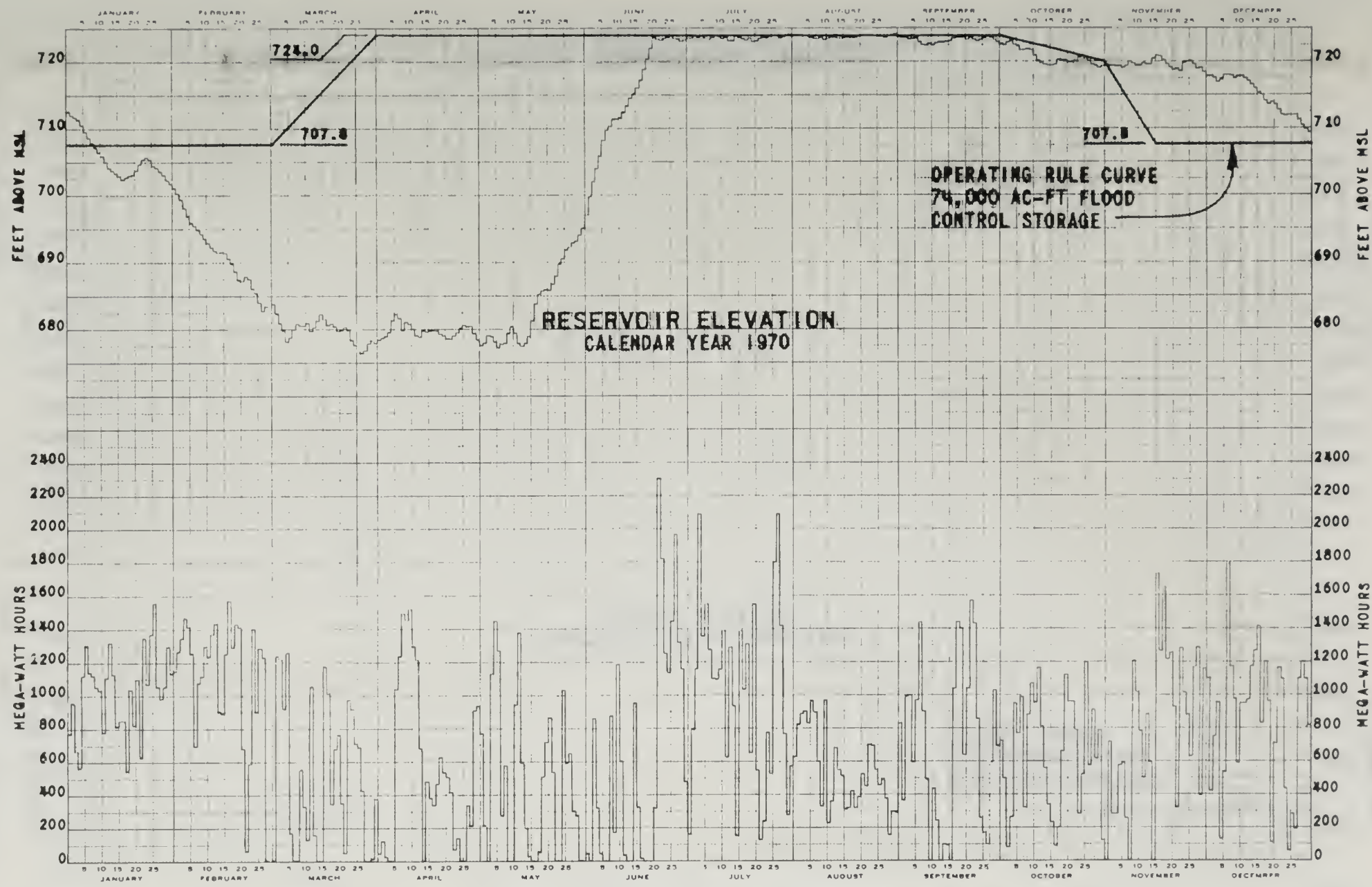
annual costs and benefits were derived for various amounts of additional flood control storage at Upper Baker project. This procedure established the amount of additional flood control storage that would produce the greatest net benefits. Plate F-8 shows the results of 1974 economic analysis, based on 1973 prices, with net benefits maximized at $1,145,000 for 58,000 acre-feet in additional flood storage capacity at Upper Baker project. An update to 1974 prices, and adjustments to conform to recently adopted revised procedures for evaluating future flood damage reduction benefits, results in the recommended plan producing $693,000 in average annual net benefits.



POWER GENERATION (ENERGY)
CALENDAR YEAR 1969

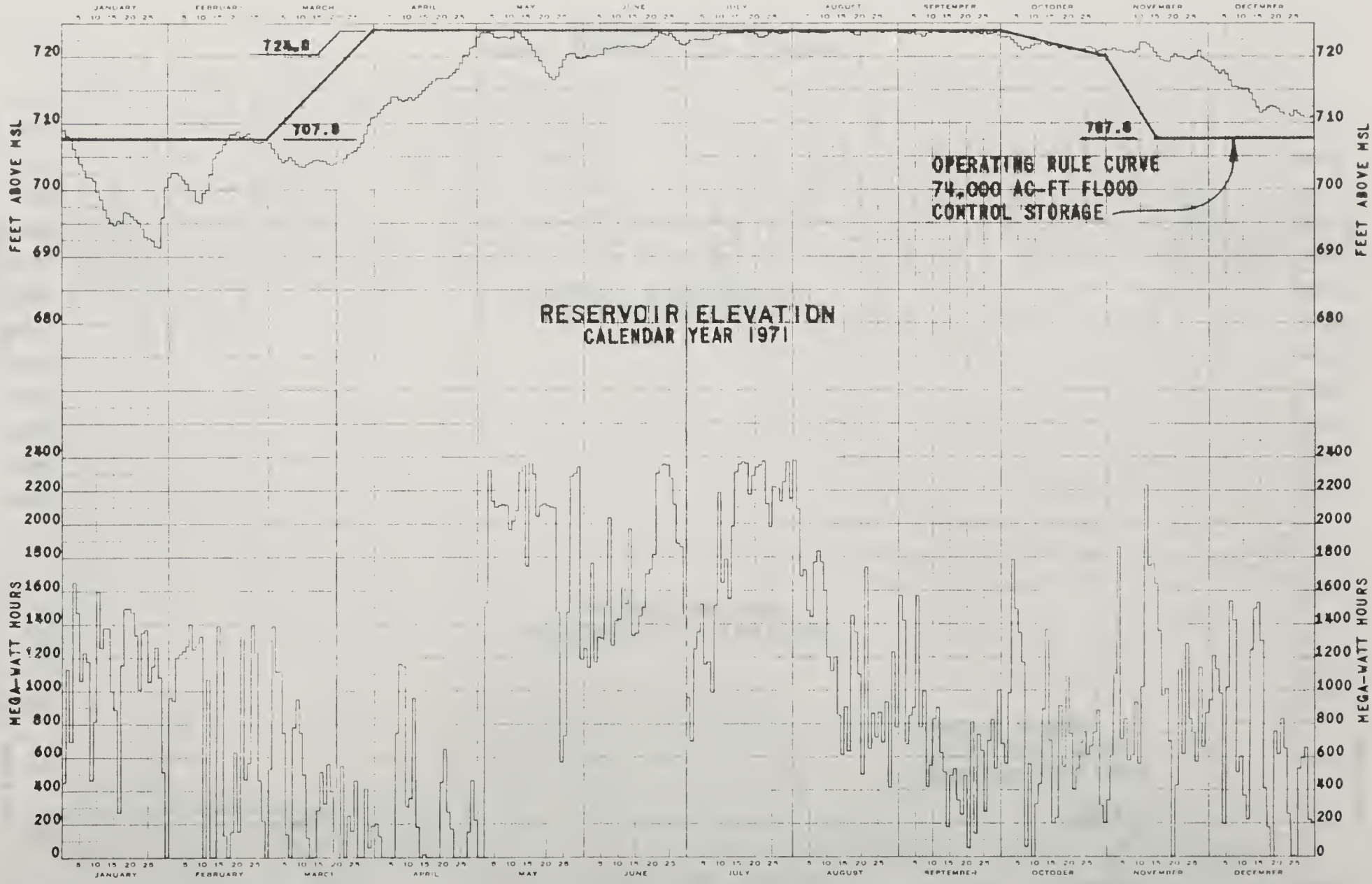
APPENDIX PLATE F-1

89-260 O - 77 - 15



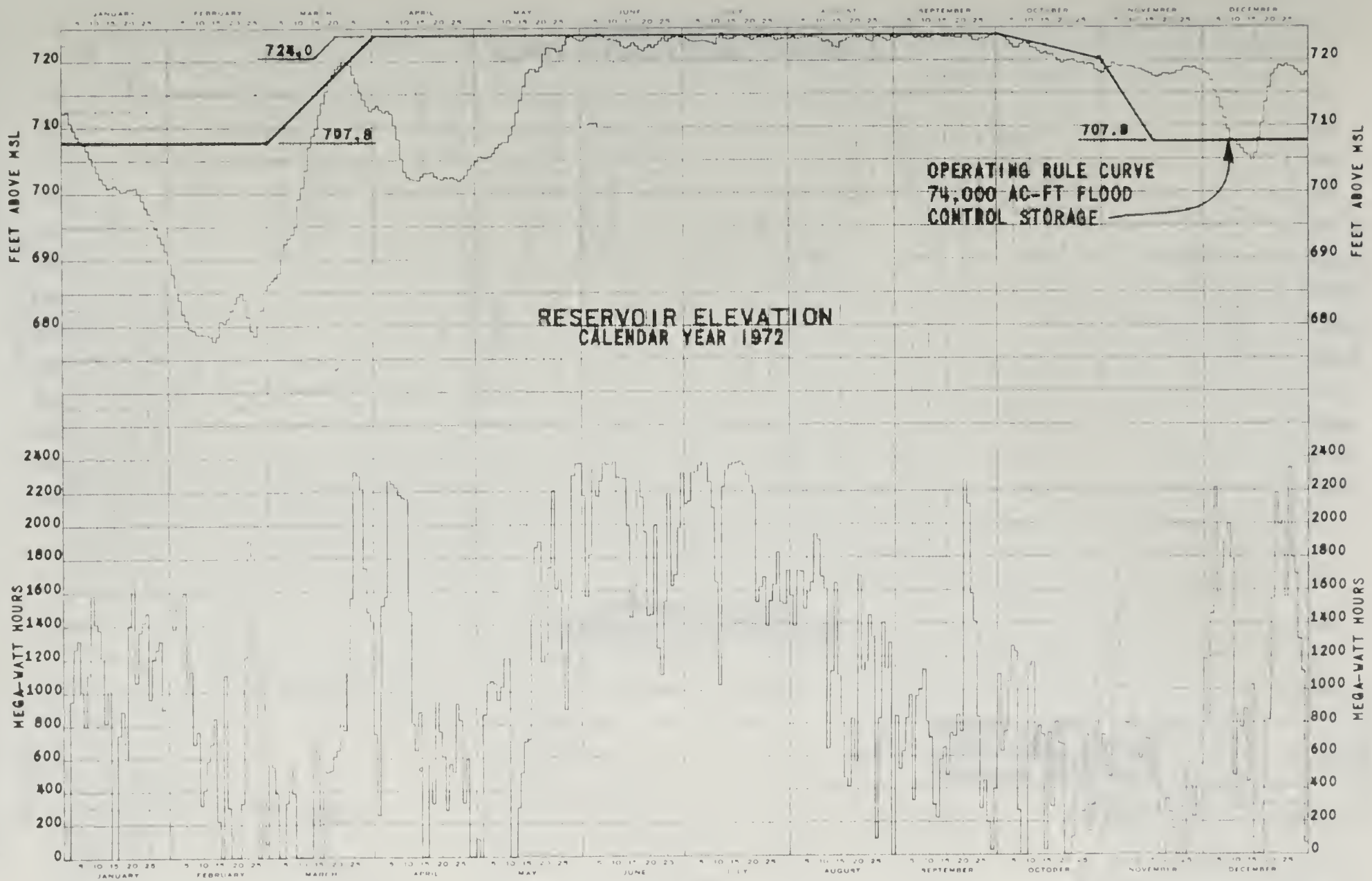
POWER GENERATION (ENERGY)
CALENDAR YEAR 1970

APPENDIX PLATE F-2



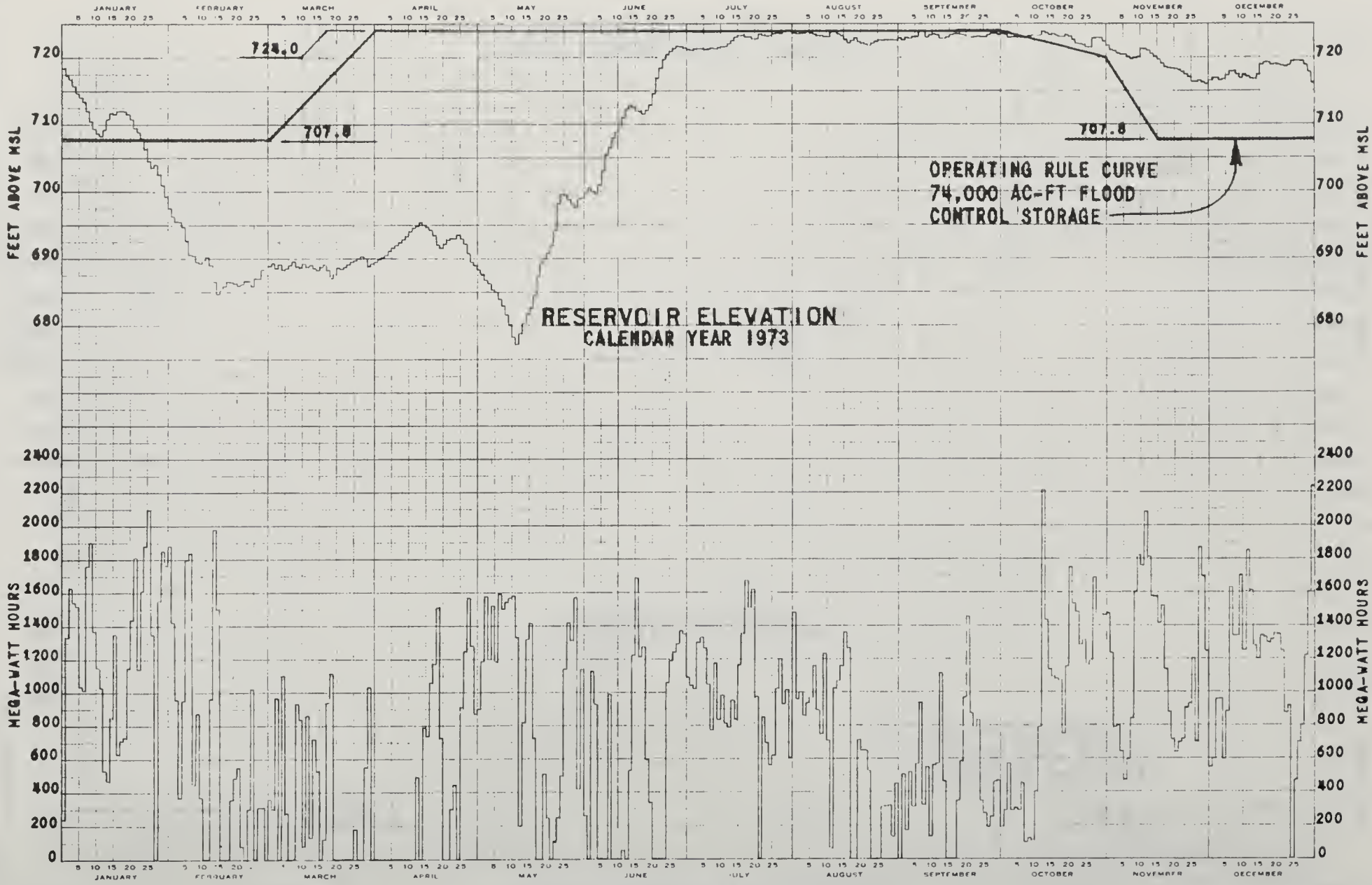
POWER GENERATION (ENERGY)
CALENDAR YEAR 1971

APPENDIX PLATE F-3



POWER GENERATION (ENERGY)
CALENDAR YEAR 1972

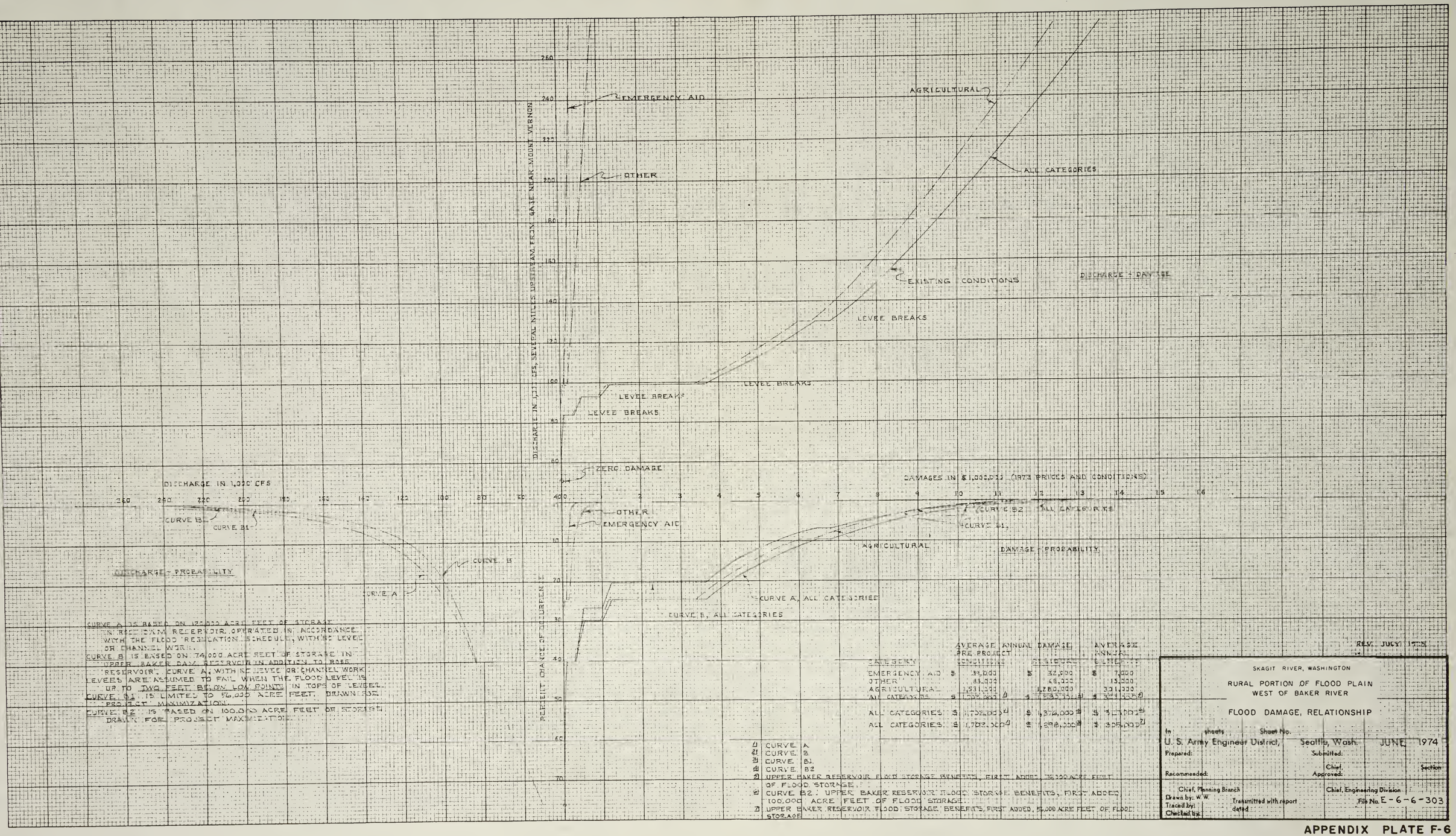
APPENDIX PLATE F-4



POWER GENERATION (ENERGY)
CALENDAR YEAR 1973

APPENDIX PLATE F-5

89-260 O - 77 (Face p. 204) No. 1



CATEGORY	AVERAGE ANNUAL DAMAGE PRE-PROJECT CONDITIONS	POST-PROJECT CONDITIONS	AVERAGE ANNUAL BENEFITS
EMERGENCY AID	$ 39,000	$ 32,000	$ 7,000
OTHER	83,000	68,000	15,000
AGRICULTURAL	1,531,000	1,280,000	301,000
ALL CATEGORIES	$ 1,653,000 [1]	$ 1,380,000 [3]	$ 323,000 [5]
ALL CATEGORIES	$ 1,706,000 [2]	$ 1,378,000 [4]	$ 328,000 [6]
ALL CATEGORIES	$ 1,702,500 [2]	$ 1,298,000 [4]	$ 395,000 [7]

1. CURVE A
2. CURVE B
3. CURVE B1
4. CURVE B2
5. UPPER BAKER RESERVOIR FLOOD STORAGE BENEFITS, FIRST ADDED 74,000 ACRE FEET OF FLOOD STORAGE.
6. CURVE B2. UPPER BAKER RESERVOIR FLOOD STORAGE BENEFITS, FIRST ADDED 100,000 ACRE FEET OF FLOOD STORAGE.
7. UPPER BAKER RESERVOIR FLOOD STORAGE BENEFITS, FIRST ADDED 54,000 ACRE FEET OF FLOOD STORAGE.

REV. JULY 1975

SKAGIT RIVER, WASHINGTON

RURAL PORTION OF FLOOD PLAIN WEST OF BAKER RIVER

FLOOD DAMAGE, RELATIONSHIP

In sheets, Sheet No.

U. S. Army Engineer District, Seattle, Wash. JUNE 1974

Prepared: Submitted:

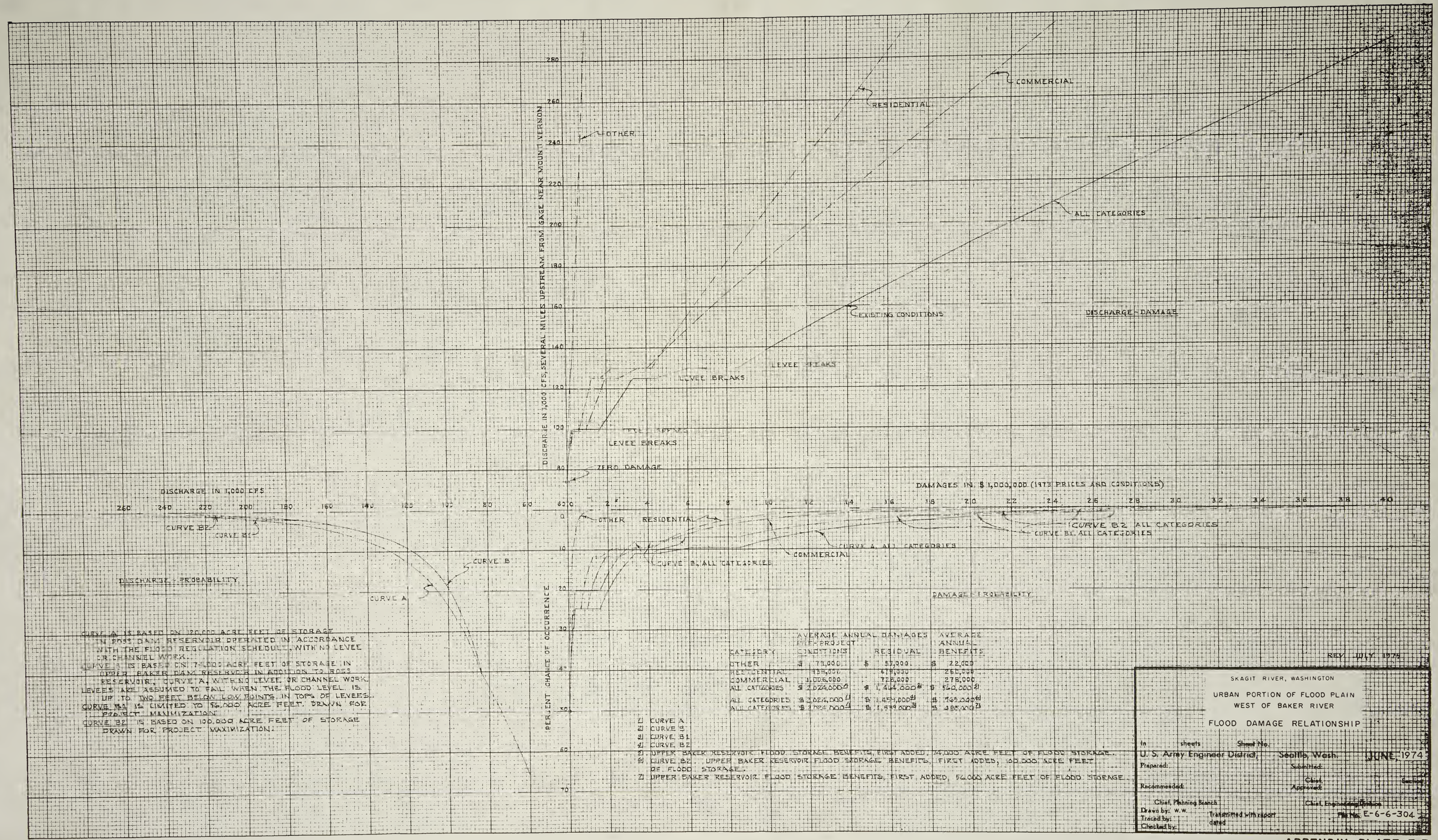
Recommended: Chief, Section Approved:

Chief, Planning Branch Chief, Engineering Division

Drawn by: W.W. Traced by: Checked by: Transmitted with report dated File No. E-6-6-303

APPENDIX PLATE F-6

89-280 O - 77 (Face p. 204) No. 1



CURVE A IS BASED ON 120,000 ACRE FEET OF STORAGE IN ROSS DAM RESERVOIR OPERATED IN ACCORDANCE WITH THE FLOOD REGULATION SCHEDULE, WITH NO LEVEE OR CHANNEL WORK.

CURVE B IS BASED ON 74,000 ACRE FEET OF STORAGE IN UPPER BAKER DAM RESERVOIR IN ADDITION TO ROSS RESERVOIR, CURVE A, WITH NO LEVEE OR CHANNEL WORK. LEVEES ARE ASSUMED TO FAIL WHEN THE FLOOD LEVEL IS UP TO TWO FEET BELOW LOW POINTS IN TOPS OF LEVEES.

CURVE B1 IS LIMITED TO 56,000 ACRE FEET, DRAWN FOR PROJECT MAXIMIZATION.

CURVE B2 IS BASED ON 100,000 ACRE FEET OF STORAGE DRAWN FOR PROJECT MAXIMIZATION.

CATEGORY	AVERAGE ANNUAL DAMAGES PRE-PROJECT CONDITIONS	RESIDUAL	AVERAGE ANNUAL BENEFITS
OTHER	$ 71,000	$ 57,000	$ 22,000
RESIDENTIAL	435,000	679,000	268,000
COMMERCIAL	1,006,000	728,000	278,000
ALL CATEGORIES	$ 2,024,000 [1]	$ 1,464,000 [3]	$ 568,000 [5]
ALL CATEGORIES	$ 1,024,000 [2]	$ 1,459,000 [4]	$ 565,000 [6]
ALL CATEGORIES	$ 1,024,000 [2]	$ 1,459,000 [3]	$ 565,000 [5]

[1] CURVE A.
[2] CURVE B.
[3] CURVE B1.
[4] CURVE B2.
[5] UPPER BAKER RESERVOIR FLOOD STORAGE BENEFITS, FIRST ADDED, 74,000 ACRE FEET OF FLOOD STORAGE.
[6] CURVE B2 - UPPER BAKER RESERVOIR FLOOD STORAGE BENEFITS, FIRST ADDED, 100,000 ACRE FEET OF FLOOD STORAGE.
[7] UPPER BAKER RESERVOIR FLOOD STORAGE BENEFITS, FIRST ADDED, 56,000 ACRE FEET OF FLOOD STORAGE.

REV. JULY 1975

SKAGIT RIVER, WASHINGTON

URBAN PORTION OF FLOOD PLAIN WEST OF BAKER RIVER

FLOOD DAMAGE RELATIONSHIP

In sheets Sheet No.

U. S. Army Engineer District, Seattle, Wash. JUNE 1974

Prepared: Submitted:

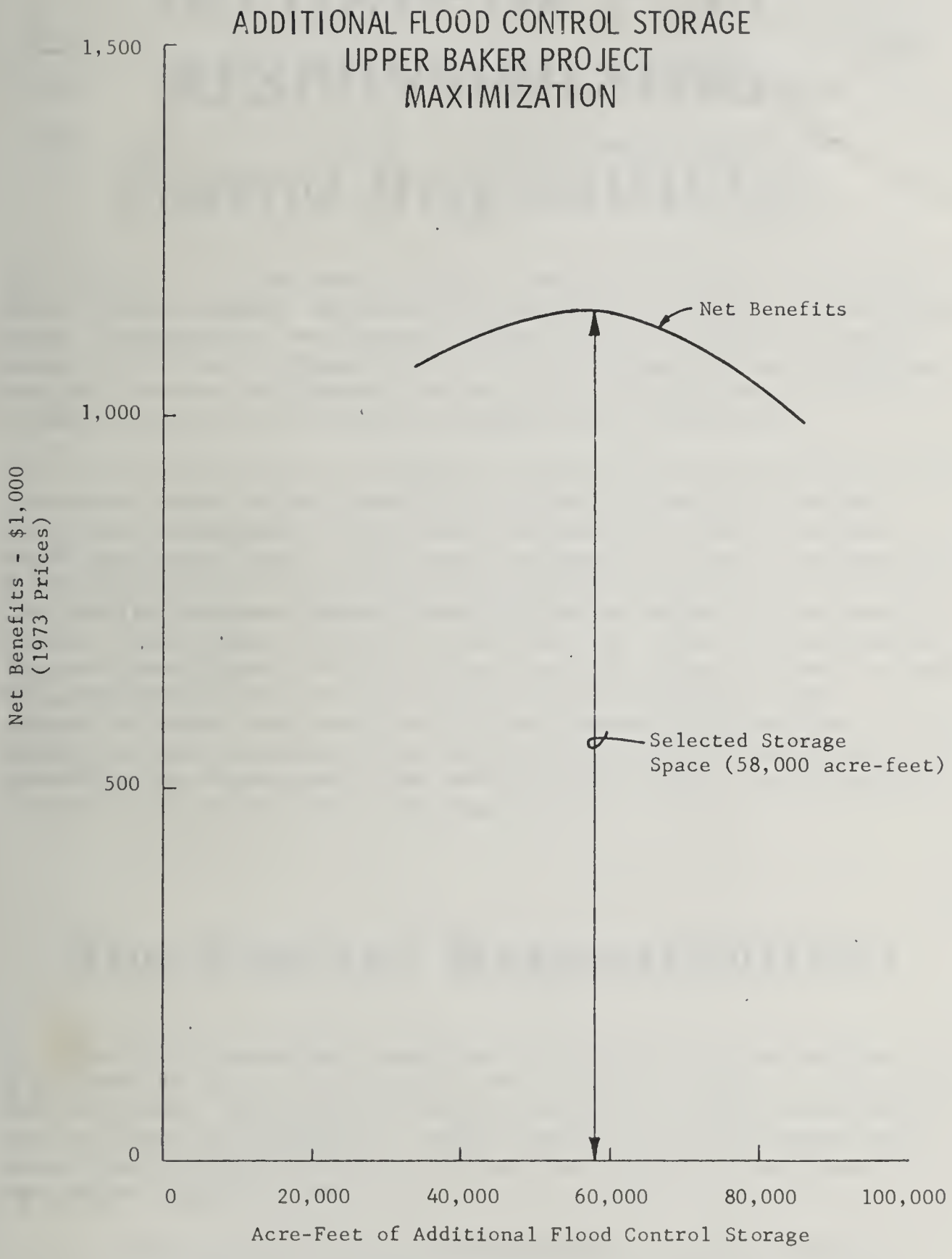
Recommended: Chief, Approved:

Chief, Planning Branch Chief, Engineering Division

Drawn by: W.W. Traced by: Checked by: Transmitted with report dated File No. E-6-6-304

89-260 O - (Face p. 204) No. 2

APPENDIX PLATE F-7



APPENDIX PLATE F-8

DIVISION OF PLAN RESPONSIBILITIES

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DIVISION OF PLAN RESPONSIBILITIES

Federal Responsibilities

1. Article 32 of the Federal Power Commission license for the Upper Baker project enables operation of Upper Baker Project for flood control. Consequently, no license change would be required for implementation of the recommended plan. However, Congressional authorization is required for Federal compensation of Puget Power for power losses that would result from the additional flood control.

2. The U.S. Army Corps of Engineers and Bonneville Power Administration would share in the responsibility for carrying out the plan. The Corps of Engineers would verify computed power losses as they occur and request their replacement by Bonneville Power. Bonneville Power would provide Puget Power with energy and capacity in kind from the Pacific Northwest Federal Power System as makeup for the power losses. The Federal Government would bear the total cost of providing additional flood control. Actual costs in terms of power revenues foregone would depend on the power losses experienced and the Bonneville Power rate schedule in effect during any given year. The annual revenues foregone by the Bonneville Power Administration in providing the replacement power would be considered a nonreimbursable Federal flood control cost (see page E-10).

Non-Federal Responsibilities

3. Flood plain management measures called for in the recommended plan, such as zoning and building codes and flood proofing of individual structures, are currently being undertaken by local governments and the State of Washington. Skagit County's only requirement would be to reaffirm their intention to continue existing flood plain management practices by:

a. Prescribing and enforcing regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce the flood control effectiveness of the Upper Baker Project.

b. Publicizing flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adapting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

c. At least annually, informing affected interests regarding the limitation of the protection afforded by the project.

PUGET SOUND AND ADJACENT WATERS, WASHINGTON

AUTHORIZATION REPORT FOR ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT, SKAGIT RIVER BASIN, WASHINGTON

Pertinent Correspondence

APPENDIX 2

PREPARED BY THE
SEATTLE DISTRICT, CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

PERTINENT CORRESPONDENCE

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Skagit Environmental Council

March 24, 1975

Department of the Army
Seattle District Corps of Engineers
4735 E. Marginal Way S.
Seattle, WA 98134

Gentlemen:

The Board of Directors of the Skagit Environmental Council, at a meeting held March 20, 1975, voted to approve the so-called "Upper Baker Project--Skagit River Flood Damage Reduction" Project subject to the following reservation:

This organization feels strongly that additional so-called flood control dams specifically on the Sauk River are highly inappropriate and unneeded. Living in the valley, we are concerned with the potential of flooding. However, we are also concerned with the aesthetics of the Sauk Valley and with the fisheries resource of the Skagit River which is substantially dependent on the Sauk River. Since the Upper Baker Dam is already in place, we think it much more appropriate to use this facility for flood control than to construct an additional, unneeded facility.

The Council, therefore, goes on record as endorsing compensation for Puget Power in return for flood control measures in the Skagit Valley. This endorsement is predicated on our contention that the current five dams on the Baker and Skagit Rivers are in all probability sufficient to prevent flood damage to the Valley, save in most unusual circumstances. Our opposition to a proposed dam on the Sauk River is unanimous and non-negotiable. We feel the two projects are definitely inter-related and that we cannot take an affirmative position on this project without voicing strong opposition to the other project simultaneously.

Sincerely yours,

Margaret M. Yeoman

1975 President
Skagit Environmental Council

FTD/bjs

Skagit Conservation District

1619 South 2nd · Mount Vernon, Washington 98273

April 3, 1975

Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington

Gentlemen:

The Skagit Conservation District wishes to reiterate it's position presented to you two years ago as regards the Upper Baker Project.

Our Board of Supervisors fully supports alternatives three (3) as a beginning of an overall comprehensive flood control program for the Skagit. We feel increased control thru the Upper Baker Project and levee improvement on the lower river is absolutely essential for a beginning of a comprehensive flood control program for all the Skagit.

We also reiterate our request previously made to the Corps for a feasibility study on some type of flood control structure for the Sauk River before Congress is asked to act on inclusion or not of the entire Skagit River system under some classification under the Wild and Scenic Rivers System.

We continue to be concerned that the Baker Project and improved dikes on the lower Skagit will lead people to feel that they have more protection than will be actually provided by these improvements, important as they are.

Alternative three (3) is a start toward flood protection vital for this community. We feel the continued preservation of this areas resources and assets is dependent on improved flood protection up to at least a fifty year frequency.

Skagit Conservation District Supervisors

BH/rk

Bob Hulbert, Chairman
Lyle Wesen
Floyd Nelson
Cliff Magin
Jess Knutzen

The Izaak Walton League of America

BUILDING A BETTER OUTDOOR AMERICA

April 15, 1975

District Engineer
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Gentlemen:

Thank you for your letter of February 26, 1975 regarding the upper Baker Project, Skagit River Basin. We appreciate the opportunity to review your proposed report on the Project.

As is described in your report the proposal is to draw the reservoir down approximately 13 feet during October and November to provide 58,000 acre feet of additional flood control storage during the winter months. Before it would normally be drawn down for the generation of hydro power.

From our review of the project report we concur the effect on the environment would be minimal. It also appears that there would be very little adverse effect on recreation.

The comments by the fishery, the wildlife environmental and recreational agencies seem to be appropriate and we concur with them. We have no further comments to offer.

Sincerely,

Larry L Petersen

Larry L. Petersen
President
Greater Seattle Chapter
of the Izaak Walton
League of America

LLP:dsp

PUGET SOUND POWER & LIGHT COMPANY

Puget Power Building - (206) GLencourt 4-6363
BELLEVUE, WASHINGTON
98009

May 3, 1974

Mr. Sydney Steinborn
Chief, Engineering Division
Department of the Army
Corps of Engineers
Seattle District
1519 Alaskan Way South
Seattle, Washington 98104

Dear Mr. Steinborn:

In your letter of April 10, 1974, you requested an additional study to determine the power losses at the Baker River Project with 74,000 acre-feet of storage reserved for flood control purposes. You supplied a rule curve that indicated that the draft of 74,000 acre-feet shall be completed by November 15 and held until March 1 each year. We have completed this study and it is identified as Case IV.

As you recall, Case I is the reference case where the project is operated nearly full all year except for the period November through February when 16,000 acre-feet of storage is provided for flood control. 74,000 acre-feet of storage requires that the Upper Baker reservoir be drafted to elevation 707.8. The operating rule curves for Case I and Case IV are shown on the attached figure. The Lower Baker Reservoir was set at 437.0 feet for the period November through April. The Lower Baker Plant was assumed to have one unit with a peak capability of 71.4 mw.

The flows used in Case I and Case IV were actual daily natural flows at the plants that cover a 45-year period beginning July 1928 and ending June 1973. The normal low natural flow during March does not let the Upper Baker reservoir completely refill. In most years the reservoir does refill by the end of April. Daily routing of these natural flows and proportional draft indicates that spill is required during the month of November to meet the flood control elevation in some years. The energy figures shown in the tabulation have been adjusted for the water that would have had to have been spilled in these months to bring the reservoir down to the rule curve.

On the attached sheet, designated "Peak Comparison," the loss of peaking capability for the months of November through March amounts to a maximum of 6.3 megawatts under the Case IV conditions. This capacity loss is directly related to the loss in elevation head between 720.6 feet and 707.8 feet.

The attached sheet, entitled "Energy Comparison," shown the 45-year output of Upper Baker and Lower Baker for both Case I and Case IV as a total in megawatt months. This total of 603.3 mw-months equates to an annual average of 1.117 mw or 2.681 mw over the five-month flood control period.

This comparison reflects the maximum energy loss as indicated by an optimum operation under Case I rule curve condition and the imposed operation of the Case IV rule curve. Under the conditions of replacement of power and energy in time and kind, the actual expected losses will probably be less than indicated by this comparison.

A resume' of the methodology used in the power loss study is attached. Puget stands ready to answer any questions you may have. Please free free to call this office.

Very truly yours,

John W. Ellis
Executive Vice President

Attachments

89-260 O - 77 - 16

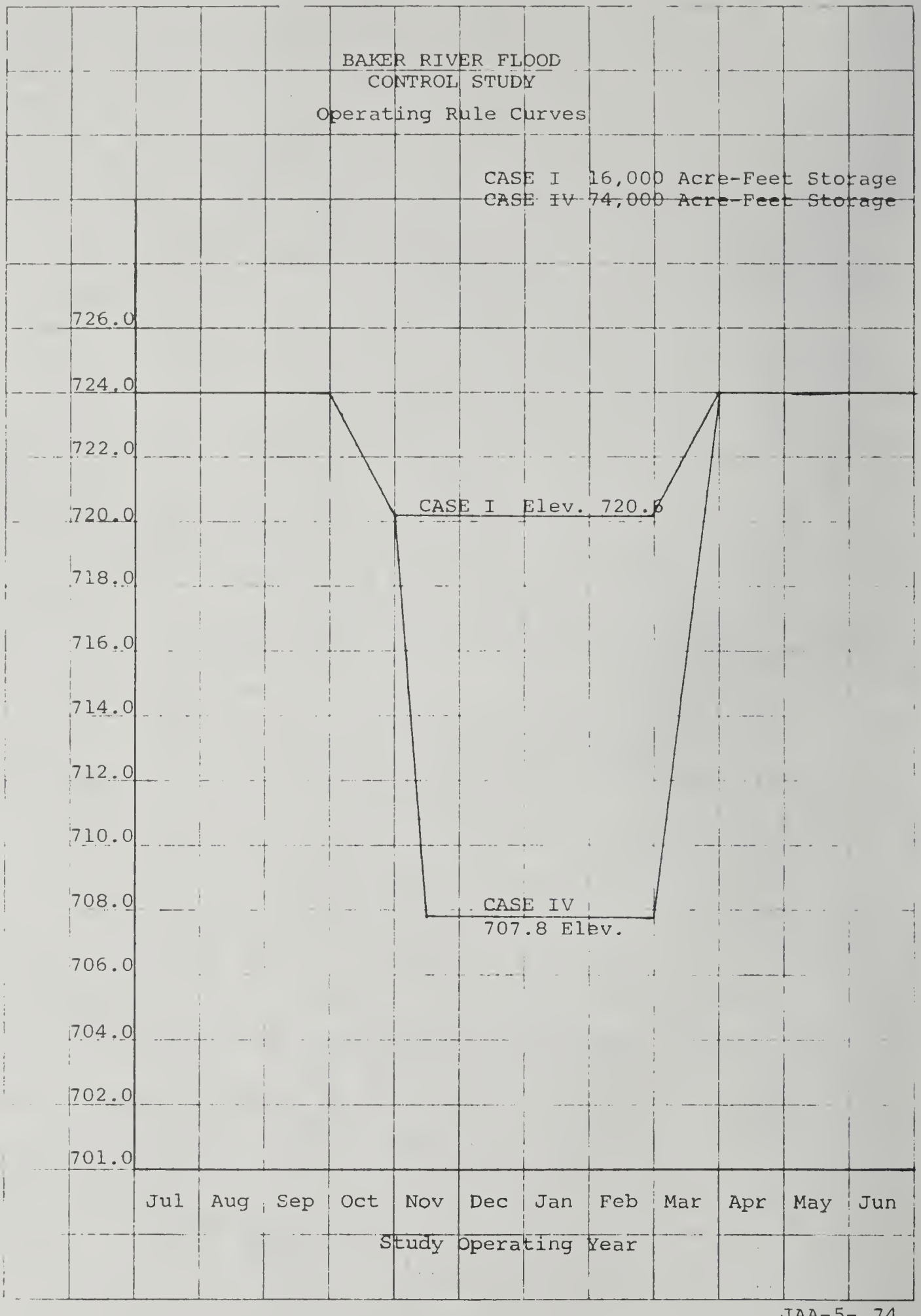
PEAK COMPARISON

A SUMMARY OF CAPACITY LOSSES FOR UPPER BAKER FLOOD CONTROL STUDIES

Month	CASE I		CASE IV			
	Upper	Lower	Upper	(Dif.)	Lower*	(Dif.)
July	100.5	71.4	100.5	-	71.4	-
August	100.5	71.4	100.5	-	71.4	-
September	100.5	71.4	100.5	-	71.4	-
October	100.5	71.4	100.5	-	71.4	-
November	99.7	71.0	99.5	(0.2)	71.4	.4
December	99.7	70.8	93.4	(6.3)	70.8	-
January	99.7	70.8	93.4	(6.3)	70.8	-
February	99.7	70.8	93.4	(6.3)	70.8	-
March	101.0	70.8	99.6	(1.4)	70.8	-
April	101.0	71.4	100.7	(0.3)	71.4	-
May	100.5	71.4	100.5	-	71.4	-
June	100.5	71.4	100.5	-	71.4	-

* Lower Baker 1928-29 hydro conditions.

JAA
5-1-74


BAKER RIVER FLOOD
CONTROL STUDY
Operating Rule Curves
CASE I 16,000 Acre-Feet Storage
CASE IV 74,000 Acre-Feet Storage
726.0
724.0
722.0
720.0
718.0
716.0
714.0
712.0
710.0
708.0
706.0
704.0
702.0
701.0
CASE I Elev. 720.6
CASE IV
707.8 Elev.
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Study Operating Year

JAA-5- 74

RESUME' OF METHODOLOGY

Studies performed to determine the power and energy losses of the Baker Project were made with a computer code entitled, "Baker River Hydro-Reg."

This computer program is a mathematical model of the Upper and Lower Baker Plants. The model consists of power Generation module and a reservoir module for each plant. The power generation module develops power from the routed natural flow and any storage as dictated by the rule curves for each day. The generation module computes the hydraulic head from the reservoir elevation and the tailwater characteristics. The capacity and energy are selected from (P-Q-H) tables that correspond with the hydraulic head and plant discharge. Daily reservoir elevations are determined by proportion draft to meet specific rule curve elevation.

The parameter which defines the study conditions are the historical natural flows, the design of the reservoir rule curve and the physical characteristics of the plants.

The output is printed on magnetic tape and hard copy. The hard copy shows all physical characteristics for each plant for each day. This includes:

1. Month
2. Day
3. Year
4. Natural flow at site (QN)
5. Draft from upstream storage (QUS)
6. Draft from at site storage (QS)
7. Total plant discharge (QD)

8. Spill (SPILL)
9. Accumulated draft (MSFM & MSFD)
10. Reservoir elevation (ELEV)
11. Conversion factor (H/K)
12. Power from natural flow (PN)
13. Power from storage (PS)
14. Average power (PA)
15. Capability (P)
16. Plant identification (PL-ID)
17. Accumulated Draft at site (SEINIT)

The hard output for a 45-year study is a very large volume. A computer code titled, "Summary" has been developed to summarize the results of these studies. Monthly results on an annual basis for each study year are printed in hard copy form for ease of analysis.

PUGET SOUND POWER & LIGHT COMPANY

PUGET POWER BUILDING - (206) 454-6363
BELLEVUE, WASHINGTON 98009

May 21, 1975

Mr. Frank J. Urabeck
Study Manager
Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Urabeck:

Additional Flood Control at
Upper Baker Project

Enclosed is a statement of approval for flood control storage in Baker Lake which I presented at a public meeting held April 8, 1975 in Mount Vernon.

The purpose of this statement was to explain Puget's position on the U.S. Army Corps of Engineers Draft entitled, "Authorization Report for Additional Flood Control at the Upper Baker Project." We are most desirous to aid the Corps and Skagit County officials in whatever way necessary to bring about better flood control in the Skagit Valley, and we wish to continue to work with you to implement this flood control program should it be adopted.

If you have any further questions or desire additional information, please call.

Very truly yours,

W. J. Finnegan

W. J. Finnegan
Manager
Environmental Affairs

Enclosure

STATEMENT OF APPROVAL FOR
FLOOD CONTROL STORAGE IN BAKER LAKE
APRIL 1975

My name is W. J. Finnegan representing Puget Sound Power & Light Company.

In previous public hearings related to the Puget Sound and Adjacent Water Study, Puget Power recommended further study of the proposal which is the subject of discussion at this hearing: To modify the operation of Puget's Upper Baker reservoir for flood control purposes.

We have reviewed the U.S. Army Corps of Engineers Draft entitled, "Authorization Report for Additional Flood Control at the Upper Baker Project." In addition to environmental considerations, this report outlines operational procedures to be used at the Upper Baker reservoir to provide additional flood control capability. These procedures include:

(a) Additional drawdown of Baker Lake from the normal flood control elevations of 720.6 feet to reach a level by November 15 of 707.8 feet at which a total of 74,000 acre-feet of storage capacity would be available for flood control.

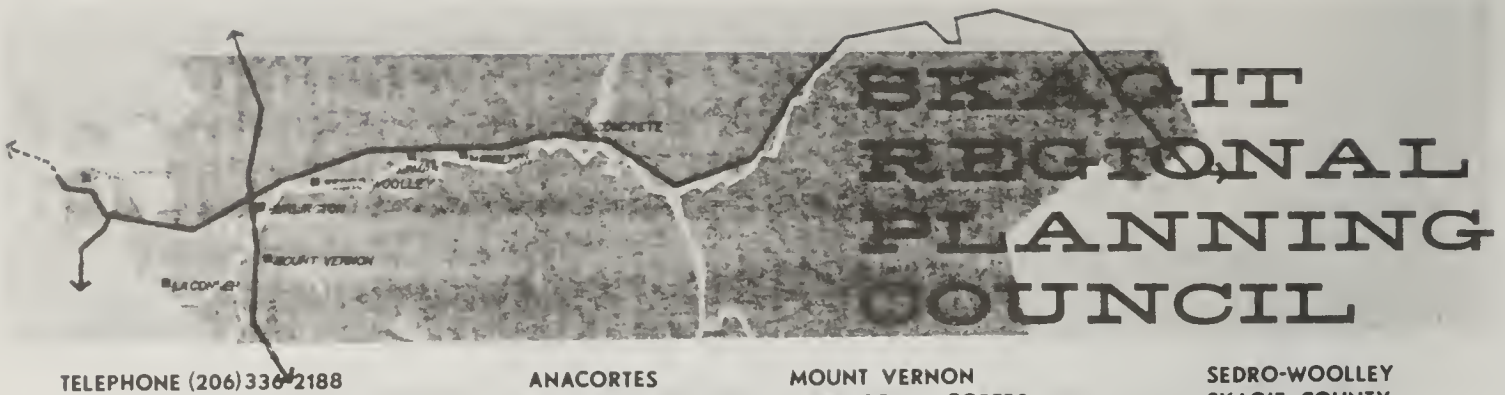
(b) This 74,000 acre-feet would be reserved for flood control until the first of March, except of course during a flood control operation. Puget Power could still draw the reservoir below elevation 707.8 during this period for power production purposes. The

required flood control storage capacity would be gradually reduced during March to permit Puget Power to refill to full pool by April 1.

Article 32 of the Project's FPC license provides that suitable arrangements shall be made to compensate the Licensee for the reservation of flood control space other than the required 16,000 acre-feet. The costs to Puget and its customers associated with this additional flood control storage are significant and economic impact is outlined on pages 45, 58 and 59 of the Report. The Report recommends Puget Power be compensated with power in kind from the Federal system by the Bonneville Power Administration. Puget has worked closely with the Corps in establishing reasonable estimates of power loss and we concur with the Report in this respect.

Puget's position throughout the entire study period has been to aid the Corps and Skagit County officials in whatever way necessary to bring about better flood control in the Skagit Valley. In fact, Puget has in the past year "used its best efforts" through the personal attention of our top executives with our Congressional delegation to gain early Federal approval for the proposal. We hereby reiterate our endorsement of the Corps' proposal and applaud their efforts relating to this matter. We will continue to work with them to implement this flood control program as soon as possible should it be adopted.

Thank you for the opportunity to appear and submit these comments.



TELEPHONE (206) 336-2188
120 W. KINCAID, ANNEX II
MOUNT VERNON, WASH. 98273

ANACORTES
BURLINGTON
LA CONNER

MOUNT VERNON
PORT OF ANACORTES
PORT OF SKAGIT COUNTY

SEDRO-WOOLLEY
SKAGIT COUNTY
SKAGIT P.U.D. NO. 1

April 3, 1975

Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Attention: Mr. Jim Newman
Environmental Coordinator

Subject: Draft Environmental Statement
additional Flood Control
Upper Baker Project
Skagit River Basin, Washington

The Skagit Regional Planning Agency has reviewed the Subject Draft Environmental Statement and concurs in general with the analysis and findings presented. We believe that the draft statement presents a fair statement of the facts as they exist at this time.

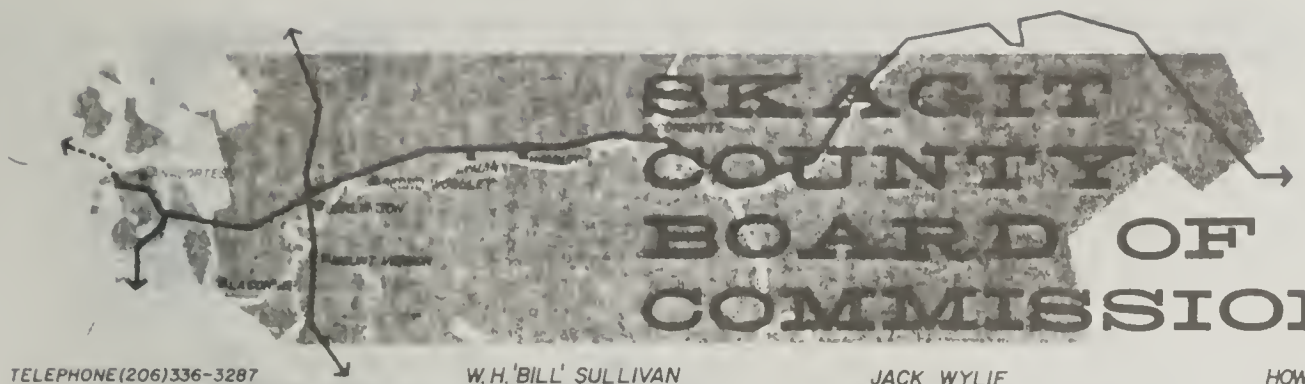
We further believe that the level of flood protection offered by a combination of the additional flood storage in Upper Baker, flood-plain management, and downstream levee and channel improvements is the minimum protection acceptable to the residents of the Skagit Valley.

Thank you for the opportunity to offer these comments.

Sincerely,

Robert C Schofield

Robert C. Schofield, Executive Director
SKAGIT REGIONAL PLANNING COUNCIL



TELEPHONE (206) 336-3287
ROOM 102 SKAGIT COUNTY COURTHOUSE
MOUNT VERNON, WASHINGTON 98273

W. H. 'BILL' SULLIVAN
1st DISTRICT
ROUTE 1, BOW

JACK WYLIE
2nd DISTRICT
2324 MANN RD., MT. VERNON

HOWARD A. MILLER
3rd DISTRICT
423 TALCOTT, SEDRO WOOLLEY

April 7, 1975

Colonel Raymond J. Eineigl
District Engineer, Corps of Engineers
Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Colonel Eineigl:

We have reviewed your draft report on Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington, and concur with the findings and recommendations contained therein. The proposal is consistent with Skagit County's Comprehensive Flood Control Plan.

As you are aware, Skagit County has qualified for the Federal Flood Insurance Program under terms of the Flood Disaster Protection Act of 1973 and is actively implementing flood plain management in cooperation with the State of Washington.

We agree to:

A. Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood-carrying capacity or in any way reduce the effectiveness of flood control operations of the Upper Baker Project.

B. Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.

C. At least annually, inform affected interests regarding the limitation of the added protection afforded by the project.

Respectfully,

BOARD OF SKAGIT COUNTY COMMISSIONERS
SKAGIT COUNTY, WASHINGTON

Howard Miller, Chairman

W. H. 'Bill' Sullivan, Commissioner

Jack Wylie, Commissioner

WASHINGTON
Department of
FISHERIES

July 9, 1974

Mr. R. Kahler Martinson
Regional Director, Fisheries & Wildlife Service
Bureau of Sport Fisheries and Wildlife
1500 N.E. Irving Street
P. O. Box 3737
Portland, OR 97208

Dear Sir:

We have reviewed your draft report on the Corps of Engineers' Upper Baker Lake Storage Project. The Department of Fisheries concurs with your findings.

Very turly yours,

Thor C. Tollefson

Thor C. Tollefson
Director

cc: Mr. J. Norville Brown

Director / Carl N. Crouse

Assistant Directors / Ralph W. Larson
Ronald N. Andrews

Game Commission

Arthur S. Coffin, Yakima, Chairman
James R. Agen, LaConner
Elmer G. Gerken, Quincy
Claude Bekins, Seattle
Glenn Galbraith, Wellpinit
Frank L. Cassidy, Jr., Vancouver

DEPARTMENT OF GAME

600 North Capitol Way / Olympia, Washington 98504

July 18, 1974

Fish and Wildlife Service
Bureau of Sport Fisheries & Wildlife
P.O. Box 3737
Portland, Oregon 97208

RE: RES - Upper Baker Lake Storage Project - draft.

Gentlemen:

The Department of Game has reviewed your draft report for the above referenced project and we support and concur with your comments.

We are enclosing a copy of a letter from Reade Brown of our department and feel that Mr. Brown's remarks will be of assistance to you in the finalizing of your report.

Very truly yours,

Carl N. Crouse, Director
THE DEPARTMENT OF GAME

By: John W. Ward
John W. Ward, Biologist III, Aquatic
Fishery Management Division

JMW/ler

cc: R. Brown
Gene Deschamps
Fisheries

Enclosure

April 14, 1975

Raymond J. Fineigl
Colonel, U.S. Army Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Subject: Upper Baker Project, Skagit River Basin

Dear Colonel Eineigl:

We have reviewed the Draft Authorization Report, Public Brochure and the Draft Environmental Impact Statement for the Upper Baker Project, Skagit River Basin and concur with the findings and recommendation contained therein.

As you are aware, the Department of Ecology is designated by Governor Evans to represent the State on these matters. In a coordinated review we have found no opposition to the recommended alternative and find that it will generally increase multiple-objective benefits (except for minor power losses).

Attached are comments on the Draft EIS that may be of assistance to you in preparing your final statement.

We, therefore, encourage early implementation of Alternative Three-Flood Plain Management with additional flood control storage at the Upper Baker Project.

Sincerely,

John A. Biggs
Director
Department of Ecology

JAB:JWS:tg
Attachment

April 14, 1975

Department of Ecology Comments:

U.S. Army Corps of Engineer's
Draft Environmental Impact Statement
Additional Flood Control
at Upper Baker Project
Skagit River Basin, Washington

Thank you for the opportunity to review your document. It appears to be an excellent presentation of the proposed action thus indicating considerable forethought in its preparation.

The comments we have are as follows:

1. There appears to be a possible misunderstanding between the terms "flood plain management" and "land use control measures." Defining each term would make the difference more easily understood.

2. Where structural measures are necessary to provide protection to existing development, it should be clear that land use and control measures are also necessary and required. This is to assure reduced flood damage on currently undeveloped land.

We hope the comments will be helpful to you. If we can be of further service to you, please contact Mr. David Thompson of our Environmental Review Section.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service (NMFS)
Columbia Fisheries Program Office
811 N.E. Oregon Street
P.O. Box 4332, Portland, Oregon 97208

May 21, 1974

District Engineer, Seattle District
Corps of Engineers
1519 Alaskan Way South
Seattle, Washington 98134

Dear Sir:

Re: Your File NPSEN PL-ER

This is in further response to Mr. Fred Weber's letter of April 26, 1974 regarding the flood control proposal Case IV for Upper Baker Lake project.

Following the May 9 meeting with your agency an intensive review of sockeye spawning records has further strengthened our concern for possible loss of redds due to stranding associated with flood control drawdowns. The Washington Department of Fisheries has estimated as many as 1400 sockeye salmon beach spawning in Upper Baker Lake in excess of fish placed into the artificial spawning beaches. Although the spawning beaches have been improved to accomodate some of these fish, we would anticipate runs of this size or even larger requiring natural spawning areas in Baker Lake.

With this in mind we again met with Washington Department of Fisheries and developed an alternate drawdown plan for your consideration as indicated below. Flood control drawdowns would be coordinated with Washington Department of Fisheries who by mid-July can estimate the size of the run of adult sockeye salmon. A large run produces fish in excess to the space available in the artificial spawning beaches and these fish must seek out natural spawning beaches in Baker Lake, spawn in Channel Creek, or other tributary streams of the lake. The Washington Department of Fisheries has advised us that such a condition would occur about one in three years.

Plan 1 - (Large run of sockeye). To prevent a loss to natural spawning the flood control drawdown would be started one day after Labor Day and would be completed by October 1.

Plan 2 - (Average or small run of sockeye). The flood control schedule would be that of Case IV which would complete drawdown by November 15, as presented in Mr. Weber's letter of April 26.

We would appreciate your views on this proposal.

Sincerely,

Fred A. Cleaver

Fred Cleaver
Program Director

cc: WDF (Lloyd Phinney)
WDC
R&S, Portland
Regional Director, WFC, Seattle

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Columbia Fisheries Program Office
811 N.E. Oregon Street
P.O. Box 4332, Portland, Oregon 97208

June 26, 1974

Colonel Raymond J. Eineigl
District Engineer, Seattle District
Corps of Engineers
1519 Alaskan Way, South
Seattle, Washington 98134

Dear Colonel Eineigl:

This is in response to Mr. Steinborn's letter of June 10 relating to Upper Baker Lake project.

As we interpret your Case IV, drawdowns would start October 1 and would be completed November 15 at elevation 707.8 feet. Under this plan, redd losses would occur to salmon beach spawning prior to October 1.

It is further noted that the drawdown would be 16,000 acre feet for October and 58,000 acre feet for November 1-15. Our concern is that the 16,000 acre feet drawdown during October may not be of sufficient magnitude to deter beach spawning, particularly as the salmon approach spawning maturity. To maximize a deterrent to sockeye beach spawning within the October 1 to November 15 dates, we recommend that the drawdown be made at a constant rate in terms of reservoir elevation during this period.

Whatever plan is developed, operational field studies are needed to properly evaluate project effects on sockeye beach spawning. This should be a project cost and we would suggest that such a study be carried out by Washington Department of Fisheries.

We would appreciate your views on a more equal spread of drawdown during the October 1 through the November 15 period and to consideration of an evaluation of project effects as a project cost.

Sincerely,

Fred Cleaver

Fred Cleaver
Program Director

89-260 O - 77 - 17

COPY

NPSEN-PL-ER 10 JUN 1974

Fred Cleaver, Program Director
National Marine Fisheries Service
Columbia Fisheries Program Office
Post Office Box 4332
Portland, Oregon 97208

Dear Dr. Cleaver:

Thank you for your 21 May 1974 letter in response to the meeting of 9 May 1974 concerning our Upper Baker Lake project and attended by Messrs. Phinney and Brown, Washington Department of Fisheries, and Department of Game; your Messrs. Black and Paunto; and Messrs. Newman and Urabeck of my staff. Although representatives of the Bureau of Sport Fisheries and Wildlife (BSF&W) were also invited to participate in this meeting, unfortunately they were unable to attend.

We appreciate the opportunity to respond to the additional proposal outlined in your letter as Plan 1, calling for drawdown of Baker Lake beginning one day after Labor Day and completed by 1 October 1974. As you point out, Plan 1 may provide fisheries benefits by decreasing sockeye salmon egg losses now experienced under present Baker Dam operating schedules. However, because of the wide concern which potential fisheries impacts have been given during our studies, perhaps a review of the project's history would now be timely before specifically addressing the merits of Plan 1.

The Upper Baker Dam, owned and operated by Puget Sound Power and Light Company (Puget Power) was identified in the Interagency Comprehensive Water and Related Land Resources study of Puget Sound and Adjacent Waters for early action to partially meet flood damage reduction needs of the Skagit River Basin. The comprehensive plan, published in 1971, called for increasing the storage capacity in Baker Lake by modifying its drawdown and release schedules. The project currently provides 16,000 acre/feet of flood control storage to compensate for valley storage lost due to construction of the project. The Federal Power

Commission (FPC) license for the project specifies that up to 84,000 additional acre/feet of flood control storage could be made available by Puget Power provided they are reimbursed for the resultant lost power.

Our current study is intended to determine through more detailed investigation whether this flood control proposal is economically justified and how Puget Power should be compensated for resultant power losses, if the proposal is implemented.

A first draft brochure detailing flood control alternatives was made available to the public, and local, State, and Federal agencies on 7 November 1972. A second draft brochure was made available April 1973. In these brochures we set forth three alternatives: (1) no action, (2) flood plain management comprised of early warning, flood proofing, insurance and land-use control, and (3) flood control storage in Baker Lake, using the (FPC) approved 84,000 additional acre/feet storage coupled with flood plain management. Based on comments we received at a public meeting held in Mount Vernon on 25 April 1973, we concluded that alternative three should receive further study. We have subsequently completed detailed hydrologic studies and have concluded that 74,000 acre/feet total storage (58,000 additional) will enable us to effectively reduce the impact of Baker River's contribution to Skagit River peak discharge at Concrete for the 100-year flood. This is the Plan 2 condition referred to in your 21 May 1974 letter.

On 15 March 1973, a field trip to Baker Lake was organized with representatives of Federal and State agencies and Puget Power (Inclosure 1). The trip was prompted by the concerns of the Washington Departments of Game, Fisheries and Ecology, National Oceanic and Atmospheric Administration, and the BSF&W. These agencies were concerned over the possibility that our drawdown proposals would result in net increases in fisheries impacts beyond those now experienced at the existing project. Impacts were related to fish redd dewatering at high lake elevations, and the possibility that migrating salmon would not be able to access major spawning streams. The alternative being considered at that time called for drafting of Baker Lake to a 701.3-foot elevation (about 19 feet lower than called for by the current flood control rule curve). Mr. George Black represented your agency on this trip.

The 15 March 1973 inspection of the lakeshore, conducted when Baker Lake elevation was 688.3 feet, dispelled agency concerns of poor stream access. Although about 150 exposed redds were found along the lakeshore, it was brought out that since Baker Dam operations normally keeps the lake elevation at about 720.6 feet through November and sometimes well into December,

our then current proposal for additional Baker Lake flood control storage had the potential of reducing redd losses by limiting the occurrence of spawning in areas that become dry every year. We are now satisfied that by drawing down 1 October and reaching an elevation of 707.8 feet by 15 November (Case IV condition), fish would further be discouraged from spawning at higher elevations.

A subsequent meeting with BSF&W was held on 17 April 1974, at which time they informally concurred with our proposals. The reasons for concurrence were based on the fact that our proposals would not create a situation where redd losses would increase beyond that which is presently experienced. Consequently, as drawdown need not begin for flood control purposes until 1 October, any earlier drawdown would have to be justified on the basis of fishery enhancement benefits.

In our meeting of 9 May 1974, these same considerations were presented. In reference to your Plan 1, we stated that a modification in the FPC license may be needed before consideration could be given to lake drafting after Labor Day. As our current study has been scoped and funded to address only the issue of additional flood control storage, a feasibility investigation of further modification of existing reservoir drawdown schedules in the interest of fishery enhancement is not possible at this time. The FPC license is quite specific as to provision for additional flood control. Our reading of the license leads us to believe that the FPC would have to approve and include in a license revision provision for fishery enhancement. Accordingly, we suggest you discuss this further with FPC.

In conclusion, while we recognize the potential benefits of your Plan 1 and believe it may represent a significant fisheries benefit, we do not feel we can give it further consideration as part of our current study effort for the reasons stated above. Should you wish to pursue your proposal as an independent study effort, we would be pleased to assist you in whatever way we can.

We understood from discussions at the 9 May 1974 meeting that a general agreement had been reached on this issue. The Washington Department of Fisheries, also represented at the 9 May 1974 meeting, has formally concurred with this understanding by their letter of 27 May 1974 (Inclosure 2). Unless we are informed otherwise, we will assume that your agency also concurs. As our schedule calls for completion of our draft report by 1 July 1974, we would appreciate any further comments you may wish to express by 20 June 1974.

If you have any questions, please feel free to contact Mr. Jim Newman, Environmental Planner, telephone (206) 442-7023, or Mr. Frank Urabeck, Study Manager, telephone (206) 442-5006.

Sincerely yours,

SYDNEY STEINBORN
Chief, Engineering Division

2 Incl
As stated

Copy furnished: w/incl
Thor C. Tollefson, Director
Washington Department of Fisheries
General Administration Building, Room 115
Olympia, Washington 98501

J. Norvell Brown, Field Supervisor
River Basin Studies
Bureau of Sport Fisheries and Wildlife
Post Office Box 1487
Olympia, Washington 98501

Carl N. Crouse, Director
Washington Department of Game
600 North Capitol Way
Olympia, Washington 98501

Frank Thomas, Regional Engineer
Federal Power Commission
555 Battery Street
San Francisco, California 94111

United States Department of the Interior
BONNEVILLE POWER ADMINISTRATION
SEATTLE AREA OFFICE
415 First Avenue North, Room 250, Seattle, Washington 98109

In reply refer to: OS

June 24, 1974

Mr. Frank J. Urabeck, Planning Engineer
Seattle District, Corps of Engineers
Department of the Army
1519 Alaskan Way South
Seattle, Washington 98134

Dear Frank:

The attached BPA table shows the results of two studies prepared by BPA to check the peaking losses that could occur to the Upper Baker Plant with flood control storage space increased from 16,000 acre-feet (Case I) to 74,000 acre-feet (Case IV). These studies verify the peaking loss estimates of 6,300 kw developed by the Puget Sound Power & Light Company with the higher flood control storage use.

We have also reviewed the energy losses developed by Puget Sound Power & Light Company and found them to be satisfactory. However, since our review of their analysis indicated there could not be any large discrepancy we did not undertake an independent study. A copy of their summary table for energy production losses is also attached.

Sincerely,

George

George A. Tupper
Seattle Area Manager

Enclosures

UPPER BAKER FLOOD CONTROL STUDIES

	JUL (MM)	AUG (MM)	SEP (EM)	OCT (EM)	NOV (EM)	DEC (MM)	JAN (MM)	FEB (MM)	MAR (FM)	APR (MM)	MAY (FM)	JUN (FM)
CASE I (16 KAF)												
Upper Baker Elevation	724.0	724.0	724.0	720.6	720.6	720.6	720.6	720.6	720.6	724.0	724.0	724.0
Lower Baker Elevation	438.6	438.6	438.0	437.0	437.0	437.0	437.0	437.0	437.0	437.0	438.6	438.6
Upper Baker Tailwater	438.665	438.665	438.183	437.431	437.431	437.431	437.431	437.431	437.431	437.431	438.665	438.665
Head	285.335	285.335	285.817	283.169	283.169	283.169	283.169	283.169	283.169	286.569	285.335	285.335
Peak Cap.	100.534	100.534	100.727	99.668	99.668	99.668	99.668	99.668	99.668	101.028	100.534	100.534
CASE IV (74 KAF)												
Upper Baker Elevation	724.0	724.0	724.0	720.6	707.8	707.8	707.8	707.8	707.8	724.0	724.0	724.0
Lower Baker Elevation	438.6	438.6	438.0	437.0	437.0	437.0	437.0	437.0	437.0	437.0	438.6	438.6
Upper Baker Tailwater	438.665	438.665	438.183	437.431	437.431	437.431	437.431	437.431	437.431	437.431	438.665	438.665
Head	285.335	285.335	285.817	283.169	270.369	270.369	270.369	270.369	270.369	286.569	285.335	285.335
Peak Cap.	100.534	100.534	100.727	99.668	93.392	93.392	93.392	93.392	93.392	101.028	100.534	100.534
IFFERENCE	-	-	-	-	6.276	6.276	6.276	6.276	6.276	-	-	-

eservoir Elevations for Peak Capacities: MM = Mid Month; EM = End of Month.; FM = First of Month.

United States Department of the Interior
BONNEVILLE POWER ADMINISTRATION
SEATTLE AREA OFFICE
415 First Avenue North, Room 250 Seattle Washington 98109

In reply refer to OS

April 11, 1975

Mr. Frank J. Urabeck, Planning Engineer
Seattle District, Corps of Engineers
Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Frank:

In response to your request for further information relative to the cost of energy and capacity pertaining to your study of additional flood control storage at the Upper Baker Project, we have worked out the following values:

EC-6 RATE	Demand Charge	=	$ 32,950
	Transformation Charge	=	3,140
	Energy Charge	=	19,772
			$ 55,862

I believe that for our purpose at this time a figure rounded to $56,000 would be appropriate.

These numbers were based on the assumption that Bonneville would agree to deliver to Puget for the account of the Corps 10.4 billion KWH during the period from mid-November through mid-April at a rate not to exceed 2,900 KW, except that the Company may request the delivery of energy at the rate of 6,276 KW during six hours each day of said period.

Attached is a work sheet that develops the dollar value worked out at the existing EC-6 Rate. Provisions should be made in our agreement to adjust the dollar amount, either up or down, as our rates change in the future.

If you need more information, please give me a call.

Sincerely yours,/

George A. Tupper
Seattle Area Manager

WORK SHEET

	Nov	Dec	Jan	Feb	Mar	Apr	Total
Peak kw Loss - kw	6,276	6,276	6,276	6,276	6,276		
Ec-6 Rate: $1.05/kw-Demand	$ 6,590	6,590	6,590	6,590	6,590		$32,950
$0.10/kw-XFM	$ 628	628	628	628	628		$ 3,140
kwh Loss [Gain] x 10^3	[20,906]	1,345	1,106	925	22,711	5,216	
Ec-6 Rate: $0.0019/kwh	[$32,721]	2,573	2,101	1,758	43,151	9,910	19,772
						Total	$55,862

United States Department of the Interior

BONNEVILLE POWER ADMINISTRATION
P.O. BOX 3621, PORTLAND, OREGON 97208

OFFICE OF
THE ADMINISTRATOR

In reply refer to: AD

APR 22 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

On April 7, 1975, we commented on your draft environmental impact statement on Additional Flood Control at Upper Baker Project.

We have now completed our review of the draft authorization report, dated January 1975, regarding the same subject. This bureau has no comments or objections to the draft report.

Sincerely yours,

Donald Paul Hodel

Administrator

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

1500 N. E. IRVING STREET
P. O. BOX 3737
PORTLAND, OREGON 97208

Reference: RB

SEP 2 8 1974

District Engineer
Seattle District, Corps of Engineers
4736 E. Marginal Way South
Seattle, Washington 98134

Dear Sir:

This is our report on the effects your proposed Upper Baker Lake Storage project, Baker River, Whatcom County, Washington, would have on fish and wildlife resources. It has been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This report is for inclusion in your survey report being prepared under the authority of the 1962 Flood Control Act. Our evaluation is based on project engineering data and pertinent correspondence provided by your staff through June 1, 1974.

This report has been reviewed by the Washington Departments of Fisheries and Game and is generally concurred in by their agencies as indicated in the attached copies of letters from Director Thor C. Tollefson, dated July 9, 1974 and Director Carl N. Crouse, dated July 18, 1974. The report as been reviewed by the National Marine Fisheries Service.

The proposed project basically involves changing flood control operations on the Baker River by utilizing one of several alternative rule curves for storage releases. Case I is the existing condition of 16,000 acre-feet of replacement for lost valley storage. Case II involves 66,000 acre-feet of total flood control storage, and Case III 100,000 acre-feet. Case IV, developed from recent hydrologic investigations, involves 74,000 acre-feet of total storage (58,000 additional) and would enable you to effectively control peak discharges for the 100-year flood. Such an operation would not require additional construction or alteration of any existing facilities.

Past operation of the Baker Lake Reservoir has resulted in beach spawning losses of sockeye salmon. The proposed reservoir drawdown schedule could produce similar losses. In those years with large sockeye salmon runs,

considerable beach spawning would take place, and proportional losses would be expected.

We therefore concur with the comments expressed in the Washington Department of Fisheries letter of May 27, 1974, and the letter from National Marine Fisheries Service dated May 21, 1974, endorsing the use of the Case IV operations with two alternative drawdown plans. Both letters urge use of a Plan 1 drawdown schedule for this operation in those years when substantial numbers of sockeye are released into Baker Lake for natural spawning, and a Plan 2 schedule during those years when returns are either less than artificial spawning beach capacity or the excess numbers released into Baker Lake are less than a yet-to-be determined level.

Under Plan 1, drawdown would begin immediately after Labor Day and be completed by October 1. Thus, the low water level is reached before the majority of beach spawning has taken place and would eliminate losses of sockeye spawning nests which now occur periodically with the existing drawdown schedule. Plan 2 would be that of the Case IV schedule which would complete drawdown by November 15.

Please advise of any changes made in project plans so that we may re-evaluate the effects of such revisions on fish and wildlife resources of the area and prepare a revised report if necessary.

Sincerely yours,

L. Edward Perry
Acting Regional Director

Attachments

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1500 N.E. IRVING STREET
P.O. BOX 3737
PORTLAND, OREGON 97208

Reference: RB

April 2, 1975

District Engineer
Seattle District, Corps of Engineers
4735 E Marginal Way South
Seattle, Washington 98134

Dear Sir:

We have reviewed your draft environmental statement and authorization report on Additional Flood Control at Upper Baker project, Skagit River Basin, Skagit County, Washington, in response to Mr. Sydney Steinborn's February 26 letter to the Department's Office of Environmental Project Review. As instructed by the Department, we are providing the following comments directly to you covering items within our areas of jurisdiction and expertise.

Page 8, Section 2.10, Fisheries and Wildlife Resources (Draft statement). Steelhead fishing is mentioned as outstanding in Skagit River. Other important fish and wildlife values, including waterfowling on Skagit Flats, and salt water salmon fishing should be included. Economic values for fish and wildlife resources should also be stated as those for agriculture.

Page 11, Section 2.13, Land Use (Draft statement). Land use with associated water requirements in Skagit County should include fish and wildlife.

We appreciated the opportunity to comment on your draft statement.

Sincerely yours,

D. H. Rhode

Acting Regional Director

IN REPLY REFER TO:
1792 (911)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

OREGON STATE OFFICE
P O. Box 2965 (729 N.E. Oregon Street)
Portland, Oregon 97208

MAR 18 1975

District Engineer
U. S. Army Corps of Engineers
Seattle, Washington

Gentlemen:

We have reviewed the draft Environmental Impact Statement and Authorization Report for Additional Flood Control at the Upper Baker Project, Skagit River Basin, Skagit County, Washington, and we offer the following comments:

There are numerous unsurveyed islands in the Skagit River below its confluence with the Baker River and several others in Skagit Bay at the river mouth which are under BLM administration. We do not believe, though, that the proposed project will have any adverse impacts on BLM programs or plans for these Natural Resource Lands.

The Skagit River upstream from the town of Mt. Veron has been declared by the Congress as a study river for possible inclusion in the National Wild and Scenic Rivers System (PL 90-542 of 10-2-1968).

Since the proposed project will withhold water from or release water to the Skagit River, depending on the flood control cycle, the effect of the project on the possible addition to the National Wild and Scenic Rivers System should be discussed. The statement should show positive evidence of correlating this project with the scenic rivers study being conducted by the Forest Service, the lead agency for the study.

Sincerely yours,

E. J. Peterson

Acting State Director

Advisory Council
On Historic Preservation

MAR 2 0 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Corps of Engineers, Seattle District
Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

This is in response to your request of February 28, 1975 for comments on the draft environmental statement for the proposed Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that your draft environmental statement appears adequate regarding our area of expertise and we have no further comment to make at this time.

Sincerely yours,

John D. McDermott
Director, Office of Review
and Compliance

United States Department of the Interior
BUREAU OF MINES
EAST 315 MONTGOMERY AVENUE
SPOKANE, WASHINGTON 99207

Western Field Operation Center
March 31, 1975

Mr. Sidney Steinborn, Chief
Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way S.
Seattle, Washington 98134

Dear Mr. Steinborn:

Personnel in this office have reviewed the Draft Environmental Statement and Authorization Report on the Additional Flood Control at Upper Baker project, Skagit River basin, Skagit County, Washington (ER-75/212).

The proposed modification in the operation of Upper Baker Dam and Reservoir for flood control purposes would not adversely affect mineral development in the Skagit River basin. Both documents adequately discuss the basin's mineral resources commensurate with the proposed action.

We offer the following suggestions for your consideration. The environmental statement should include any adverse or beneficial impacts as they relate to the proposed Skagit River Wild and Scenic River. The Forest Service provided information from the study (Authorization Report, page A-3), but a direct reference could not be found in the statement.

The statement does not mention the proposed Skagit Nuclear Power Project located just north of the river between Sedro Woolley and Lyman. Will the project have any adverse or beneficial effects upon the proposed power project?

Increased steam venting has occurred recently from Mt. Baker. Should this increase in venting activity continue or foreshadow a general increase in volcanic activity, the results could have a great impact upon the downstream Baker River system. Such impacts as avalanches and sudden release of waters from debris dams should be discussed in this environmental statement. One of the latest references

to the increase in geothermal activity is "Recurrent Geothermally Induced Debris Avalanches on Boulder Glacier, Mt. Baker, Washington" by David Frank, Austin Post, and Jules D. F. Friedman, Journal of Research, U.S. Geological Survey, January-February 1975, Volume 3, No. 1, pp. 77-87. Further references are listed in this paper.

These comments are intended only to provide preliminary review and technical assistance and do not constitute a formal Department of the Interior or Bureau of Mines response.

Sincerely yours,

R. N. Appling, Jr., Chief
Western Field Operation Center

89-260 O - 77 - 18

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: 10RA0FA - M/S 623

April 9, 1975

Mr. Frank Urabeck, Study Manager
Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Urabeck:

We have reviewed the draft environmental impact statement on, "Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington."

This project merely proposes to utilize a portion of the existing storage space in PSP&L's Upper Baker River Project for flood control. The only change in current operation is that the reservoir will be intentionally drawn down in late fall to make flood storage available through the winter and early spring months. Power revenues foregone will be replaced at the expense of the Federal Government.

Outside of the benefits that should accrue to the project for flood control, no significant environmental impacts due to the proposal are foreseen.

Our comments on this draft statement have been classified LO-1, LO (Lack of Objections) 1 (Adequate Information). The classification and the date of the Environmental Protection Agency's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our review on proposed Federal actions under Section 309 of the Clean Air Act.

Thank you for the opportunity to review this draft statement.

Sincerely,

Walter D. Jaspers

Walter D. Jaspers
Director
Office of Federal Affairs

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
NORTHWEST REGION

APR 3 1975

IN REPLY REFER TO:

53027
ER-75/212

Sydney Steinborn, Chief
Engineering Division
Department of the Army
Seattle District Corps of
Engineers
4735 E. Marginal Way So.
Seattle, Washington 98134

Dear Mr. Steinborn:

Pursuant to your request of February 26, 1975, we have reviewed the Draft Environmental Statement and Authorization Report on the Additional Flood Control at Upper Baker Project, Skagit River Basin, Skagit County, Washington. The draft statement adequately considers areas for which this Bureau has jurisdiction and review expertise; review of the authorization report reveals the proposal would have minimum impact on recreation facilities and opportunites.

Sincerely yours,

Maurice H. Lundy
Regional Director

United States Department of the Interior
NATIONAL PARK SERVICE
Pacific Northwest Region
Fourth and Pike Building
Seattle, Washington 98101

IN REPLY REFER TO:

L7619
(PNR)CAE

April 9, 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

We have reviewed the draft environmental statement and authorization report on the Additional Flood Control at Upper Baker Project, Skagit River Basin, Skagit County, Washington (ER-75/212).

We suggest that you consult the Washington State Historic Preservation Officer to determine if any sites eligible for the "National Register of Historic Places" will be affected by the proposal. The results of this consultation should be reported and documented in the final statement.

Sincerely yours,

Glenn D. Gallison
Associate Regional Director,
Cooperative Activities

United States Department of the Interior
BUREAU OF RECLAMATION
PACIFIC NORTHWEST REGIONAL OFFICE
FEDERAL BUILDING & U.S. COURTHOUSE
BOX 043 - 550 WEST FORT STREET
BOISE, IDAHO 83724

IN REPLY
REFER TO: 160

120.1

APR 10 1975

District Engineer
Seattle District, Corps of Engineers
Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Sir:

We have reviewed the draft environmental impact statement and authorization report for Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington (ER 75/212). We have found no problems with the statement or report that would give rise to significant comment. Thank you for the opportunity of reviewing these statements.

Sincerely yours,

H R. Stiles

Assistant Regional Director

cc: Commissioner, Attn: 150
Director, Office of Environmental Project Review, USDI, WDC

IN REPLY REFER TO:
Land Services

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
PORTLAND AREA OFFICE
POST OFFICE BOX 3785
PORTLAND, OREGON 97208

APR 10 1975

Mr. Sidney Steinborn
Chief, Engineering Division
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

This is in reference to your draft environmental statement and authorization report on the additional flood control at Upper Baker Project, Skagit River Basin, Skagit County (ER 75/212).

A primary concern in the Skagit River Basin is the fishery resource. Assuming that the information concerning the resulting stream flow and spawning restrictions which will result from the lower drawdown of Upper Baker Reservoir is correct, it appears that the proposed flood control project will not diminish, and may enhance, the fishery environment. We feel it is very important to conduct future studies (as mentioned on page 53) to determine the impact upon Baker Lake spawners--and that the resulting data be used in future management and decision making.

We depend upon the Fish and Wildlife Service for technical knowledge and analysis on fishery and related biologic resource matters. It would be appreciated if we could receive a copy of their comments for our files.

Sincerely yours,

Assistant Area Director
(Economic Development)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Region 6
P.O. Box 3623, Portland, Oregon 97208

8420
April 11, 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

At your request we have reviewed the draft environmental statement on Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington. Our comments follow:

1. General Comments - The Skagit River is designated as a potential addition to the National Wild and Scenic River System under section 5 (a) of the Wild and Scenic Rivers Act. We are unable to determine the environmental impacts of each alternative considered to the potential wild and scenic river area. We recommend that the evaluation of environmental impacts consider the effects on the scenic, recreational and fish and wildlife values present in the potential river area.

   If these rivers are added to the National Wild and Scenic River System, the future construction of flood control devices which would affect the free-flowing character of these rivers would be precluded. The proposed action is compatible with National System status for the Skagit. It is addressed and supported by our forthcoming draft environmental statement on the Skagit River Study. Such a discussion could be easily added to Section 3.0 on page 44.

2. On page ii of the summary sheet, you first discuss drawdown from November 1-15. Near the bottom of the page you mention drawdown during "October and November". Drawdown should not occur until after the close of fishing season, normally October 31.

3. References to "Baker National Forest" on page 7 and "Mount Baker National Forest" on page 34, should be corrected to "Mt. Baker-Snoqualmie National Forest".

4. On page 10, Section 2.12 - there are four developed Forest Service campgrounds and 12-14 undeveloped sites along Baker Lake, not two as

the draft environmental statement states. You should also delete the word "area" after Glacier Peak Wilderness. The same comment is valid for page 12 of the authorization report and B-10 of Appendix 1.

5. Reference on page ii of the summary sheet and page 60 of the DES discuss the exposure of a maximum of 12.8 feet of shoreline. This is a vertical distance, which may be considerably greater on gently sloping shorelines. It should be noted that this exposure occurs at the worst time as far as shoreline erosion is concerned, since precipitation during this period normally occurs as rain, rather than non-erosive snow. The degree of impact might be placed in better perspective if the number of additional acres exposed could be quantified, and compared to the present acreage exposed in an average year.

6. Page 5 of the Appendix should be corrected to read "National Wild and Scenic River System."

We appreciate the opportunity to review you D.E.S. and trust our comments will assist you in preparing the final statement.

Sincerely,

FOR T.A. SCHLAPFER
Regional Forester

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

ER-75/212

APR 15 1975

Mr. Sydney Steinborn, Chief
Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

We have reviewed the draft environmental impact statement on Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington, and the draft authorization report, as you requested in a letter of February 26 to the Office of Environmental Project Review. We offer the following comments for your consideration.

Environmental impacts related to geologic conditions are adequately discussed in the environmental statement.

We find the subject documents to be adequate and generally accurate in their assessment of the impact of the proposed actions on water resources of the area. However, we submit the following specific comments.

Draft Environmental Statement

Page 9, second paragraph, sentence 1: This statement is generally true. However, recently Mt. Baker has shown increased activity and water in Boulder Creek, which drains an area near one of the new steam vents, has been reported to have a pH of near 3.7 and a specific conductance of about 500 micromhos.

Page 52, first paragraph, lines 6 and 7: If "there is a potential for further reductions of present spawning . . ." then it would seem that redd losses would be increased.

Page 70, first sentence: This sentence should emphasize that if levee and channel improvements are implemented, the improvement in flood

protection would only occur in the river system downstream from Burlington. Flooding upstream from that point would probably still occur at a 2-3 year recurrence interval. This comment also applies to Avon Bypass (p. 70, b).

Authorization Report

Page 28: We suggest that the table be titled "Historical Skagit River Floods near Mt. Vernon."

Appendix 1, C-22, Table C-4: For the Skagit River near Concrete, the "crest discharge" should be 139,000 cfs.

We thank you for the opportunity to review and comment on these documents.

Sincerely yours,

Henry McCuller

Acting Director

FEDERAL POWER COMMISSION
REGIONAL OFFICE
555 BATTERY STREET, ROOM 415
SAN FRANCISCO, CALIF. 94111

April 23, 1975

Col. Raymond J. Eineigl
District Engineer
Seattle District, Corps of Engineers
4735 East Marginal Way
Seattle, WA 98134

Dear Sir:

We have reviewed your Draft Environmental Impact Statement and the Draft Authorization Report on the Additional Flood Control at Upper Baker Project, which were furnished with your letter of February 26, 1975.

These comments on your Draft Environmental Impact Statement by the San Francisco Regional Office of the Federal Power Commission's Bureau of Power are made in accordance with the National Environmental Policy Act of 1969, and the August 1, 1973, Guidelines of the Council on Environmental Quality. Our principal concern with developments affecting land and water resources is the possible effect of such development on bulk electric power facilities, including existing and potential hydroelectric developments, and on natural gas pipeline facilities. The action proposed in this draft statement affects the operation of a Federal Power Commission licensed project.

Your proposed plan would modify the present operation of the Upper Baker Reservoir, which is part of FPC Licensed Project No. 2150, by providing for 58,000 additional acre-feet of flood control storage by increasing reservoir drawdown during the period November 1-15 of each year. Pool elevation during this drawdown period would be reduced from about elevation 720.6 feet to elevation 707.8 feet. The additional flood control storage obtained would be available until March 1 of each year, when refilling would begin, and normally be completed April 1. You have estimated that the proposed plan would result in a capacity loss of up to 6.3 megawatts, and an energy loss of 1.117 average megawatts annually.

The present operation of the Upper Baker Reservoir provides for 16,000 acre-feet of space for flood regulation between November 1 and March 1, as specified by the Project License. Article 32 of the License further provides for up to a maximum of 84,000 acre-feet of flood control space in the reservoir during the storage drawdown season, as may be requested by the Corps of Engineers, provided suitable arrangements are made to compensate the Licensee.

We have not made an independent estimate of the energy and capacity loss incurred by the proposed plan (Alternative No. 3). We note that you have used power values furnished by this office to establish the alternative cost of replacement power for your economic evaluation. In this instance, the power values used reflect a nuclear power plant as an alternative source for the power foregone. This cost of alternative power, including annual administrative costs associated with the plan, is estimated to be $301,000 per year, to give the proposed plan a benefit-cost ratio of 4.8. Your DEIS does not, however, indicate the manner in which the power losses were estimated. It is suggested that the method of computation of these power losses be indicated in the final environmental impact statement and in the final authorization report.

The proposed plan would provide for reimbursement to Puget Sound Power & Light for the power losses through replacement power from the Bonneville Power Administration. Your estimated annual cost of this power is $80,000. As previously noted, the FPC license for the project allows for additional flood control space in the Upper Baker Reservoir, provided that suitable arrangements shall have been made to compensate the Licensee.

Alternative No. 2 should be discussed in greater detail. In the absence of adequate coverage of the flood plain management program without additional storage proposal, it is extremely difficult for the reader to determine whether or not the benefits derived from flood storage at Upper Baker would be significantly greater than those benefits derived from managing the use of the flood plain.

The consequences of protracting the length of the flood while reducing its severity are mentioned (page 3) but are not thoroughly discussed. However, the length of the February 1951 flood (page 39) is cited as a significant contributor to the severity of flood damages. These two statements appear contradictory.

We suggest that the DEIS discuss the effect, if any, of the proposed revised storage allocation on the hydro power production at the downstream Lower Baker project.

On page C-3, Appendix 1 of the Authorization Report, the installed capacity shown for Lower Baker should be changed from 103,000 kilowatts to 64,000 kilowatts. This revised capacity is due to the abandonment of two powerhouse units following severe landslide damage in 1965.

Very truly yours,

George L. Jaw Deputy

(Acting for) M. Frank Thomas
Regional Engineer

pacific northwest
river basins commission

1 columbia river • p. o. box 908
vancouver, washington • 98660

office of the chairman

June 5, 1975

Colonel Raymond J. Eineigl
District Engineer
Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way, South
Seattle, Washington 98134

Dear Colonel Eineigl:

In response to Mr. Frank J. Urabeck's memorandum dated 21 March 1975, I have reviewed Public Brochure #4 concerning Additional Flood Control at Upper Baker Project, Skagit River, Washington, March 1975.

This study addresses itself to the alternatives identified in the Puget Sound and Adjacent Water Study for obtaining flood control for the Skagit River Basin. I concur with your tentative recommendations that Alternative 3, Flood Plain Management with Additional Flood Control Storage, Upper Baker Project, be implemented. The results of this study are consistent with the findings of, and provide valuable updating elements to, the Puget Sound and Adjacent Waters Study.

These views are my own as Chairman of the Commission and do not reflect any Commission action. Thank you for the opportunity to comment on this feasibility study.

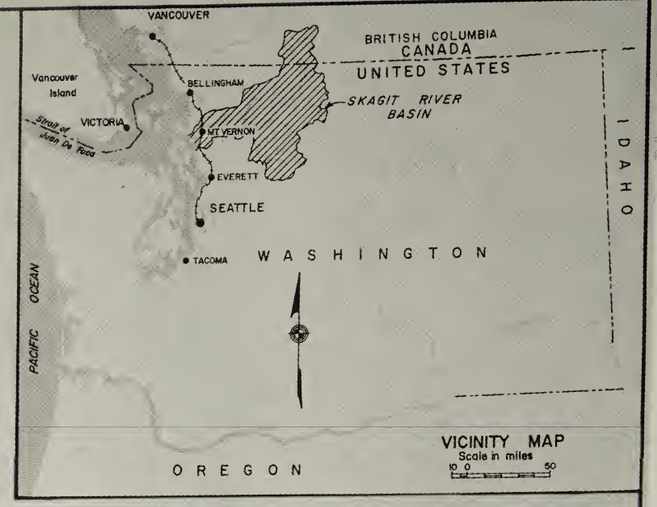
Sincerely yours,

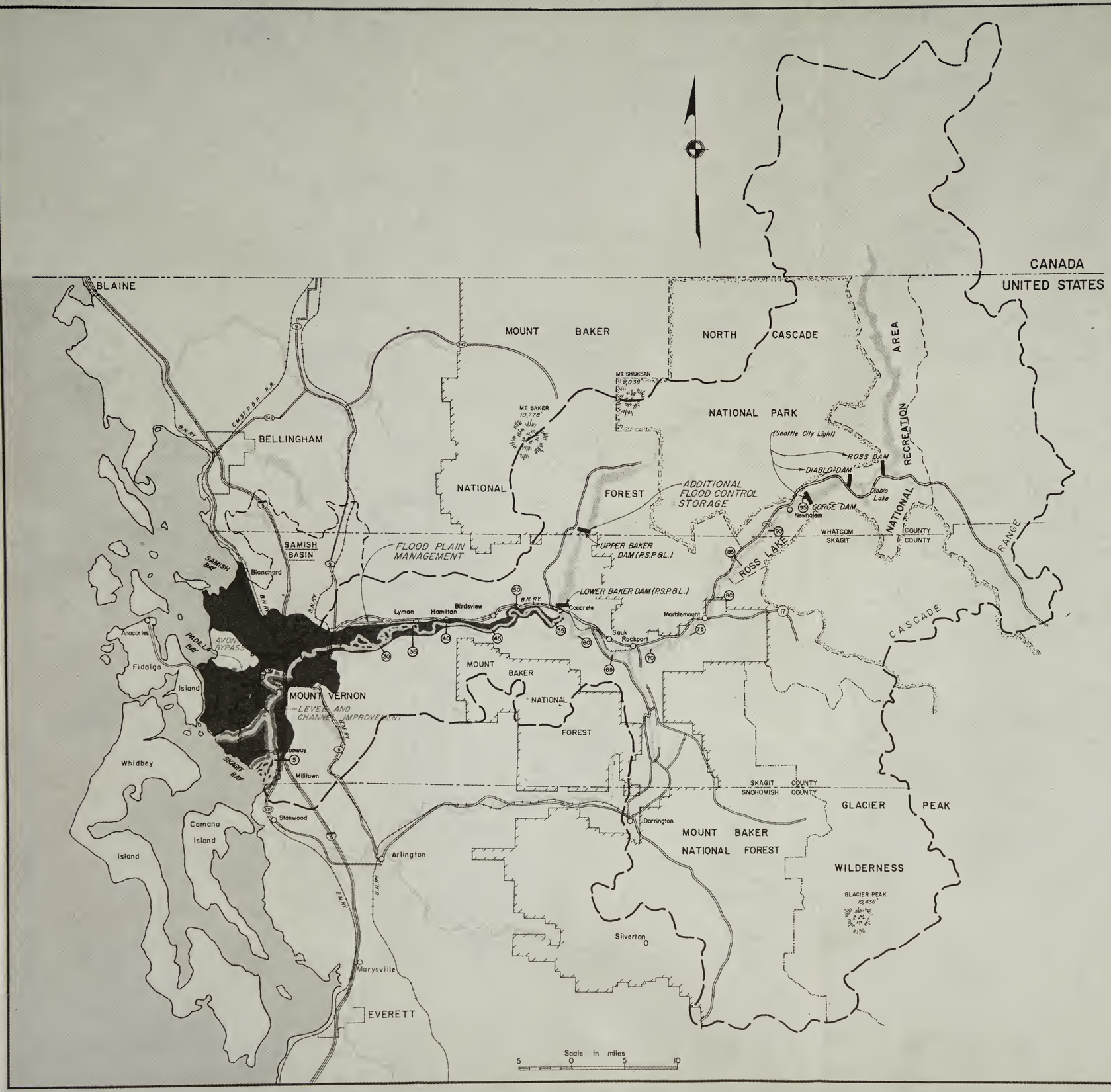
Donel J. Lane
Chairman

DJL:nr

CORPS OF ENGINEERS

U. S. ARMY





LEGEND

- EXISTING PROJECT
- FLOOD DAMAGE REDUCTION PROPOSAL
- AUTHORIZED PROJECT
- MAJOR FLOOD DAMAGE AREA

SKAGIT RIVER AND TRIBUTARIES
WASHINGTON

BASIN MAP

In sheets Sheet No. Scale: As shown

U. S. Army Engineer District, Seattle, Wash.

Prepared: Raymond A. Skinner, Chief, Basin Planning Section
Recommended: Fred H. Weber, Chief, Engineering Division
Drawn by: J.O
Traced by:
Checked by: A.J.U dated June 1975

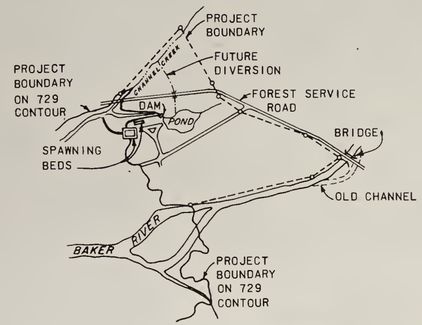
Submitted: R.P. Lethbridge, Chief, Planning Branch
Approved: Raymond Reineke, Colonel, Corps of Engineers

File No. E 6-6-306

89-260 O - 77 (Face p.262) No. 1

PLATE I

89-260 O - 77 (Face p. 262) No. 2



PLAN AT SPAWNING BEDS UPSTREAM OF RESERVOIR

SCALE IN FEET

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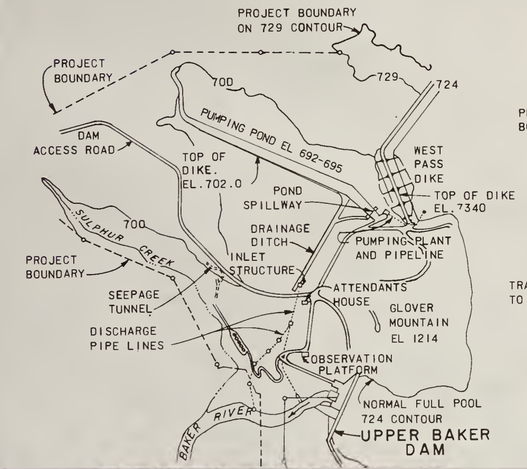

PLAN DOWNSTREAM OF RESERVOIR

SCALE IN FEET

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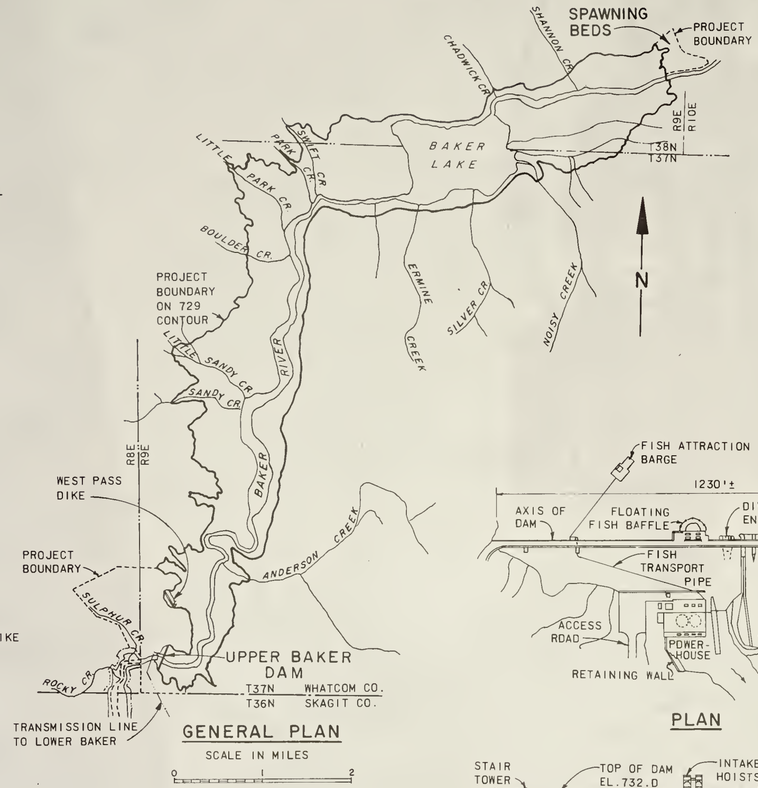
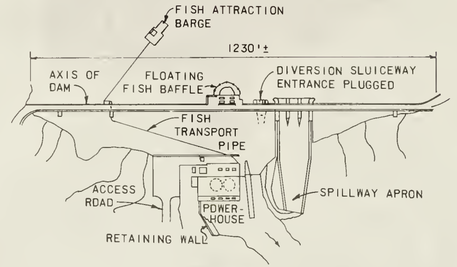


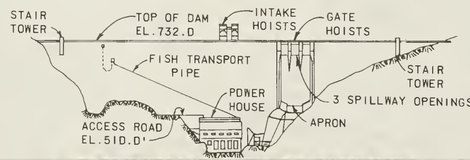
GENERAL PLAN

SCALE IN MILES

0 1 2



PLAN



ELEVATION LOOKING UPSTREAM

SCALE IN FEET

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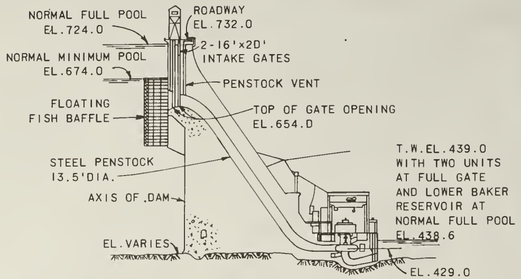
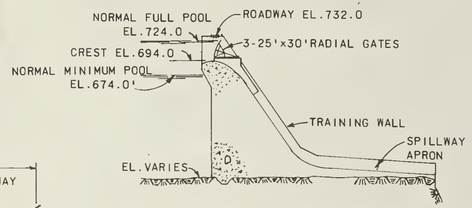
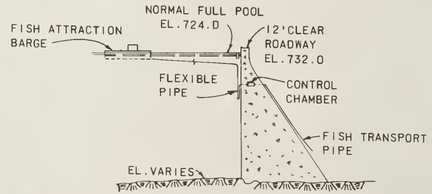


SECTION THROUGH POWER HOUSE AND INTAKE



SECTION THROUGH SPILLWAY



TYPICAL NON-OVERFLOW SECTION

SCALE IN FEET

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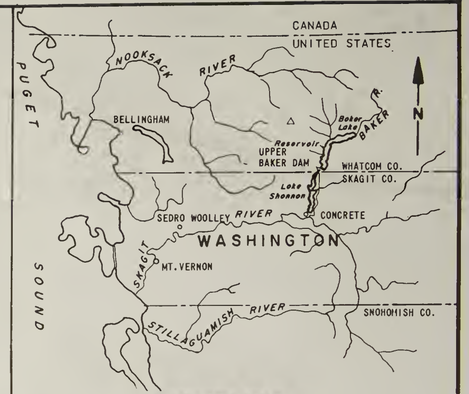

VICINITY MAP

SCALE IN MILES

0 10 20 30 40

UPPER BAKER RIVER, WASHINGTON
PUGET SOUND POWER & LIGHT COMPANY
UPPER BAKER DAM
PLANS AND SECTIONS

In 6 sheets Sheet No. 2

U.S. Army Engineer District, Seattle, Wash. 1975

Engineer: Frank J. Tabbut — Chief, Basin Plng. Section
Recommended: Chief, Planning Branch
Submitted: Raymond A. Hanks — Chief, Basin Plng. Section
Approved: Chief, Engineering Div.

Drawn by: J.O.
Traced by:
Checked by: F.J.T.

File No. E-6-6-307

PLATE 2

89-260 O - 77 (Face p. 262) No. 2

FINAL

ENVIRONMENTAL STATEMENT

Additional Flood Control At Upper Baker Project, Skagit River Basin, Washington

Prepared by
U.S. Army Corps of Engineers District
Seattle, Washington

ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT,
SKAGIT RIVER BASIN, WASHINGTON

( ) Revised Draft Environmental Statement

(X) Final Environmental Statement

Responsible Office: U.S. Army Corps of Engineers District, Seattle, WA

1. Name of Action: ( ) Administrative (x) Legislative

2. Description of Action: The Upper Baker Dam and Reservoir is an operating hydroelectric project on the Baker River in Skagit and Whatcom counties in Washington. The project is owned and operated by the Puget Sound Power and Light Company and is located about 8 miles above Concrete, Washington. The principal features of the Upper Baker Dam include: A concrete gravity dam about 330 feet high with a spillway crest elevation of 694 feet and containing some 600,000 cu. yd. of concrete; a powerhouse containing two 47,200 kW nameplate turbine generating units; a usable water storage capacity of 220,630 acre-feet between normal maximum pool elevation of 724 feet and minimum operating pool elevation of 655 feet. The project provides 16,000 acre-feet of flood control storage space from November through February. Drawdown for power generation has resulted in the past in Baker Lake falling below elevation 700 feet by the middle of January and occasionally by mid-December, and to 680 feet by February.

This environmental impact statement presents potential effects of a proposed modification in the operation of the dam for flood control purposes. The details of this modification concentrate on providing up to 58,000 additional acre-feet of flood control storage by increasing reservoir drawdown in the period 1 November to 15 November of each year. The pool elevation on 1 November would be about 720.6 feet or less depending upon power generator operation of Puget Power. By 15 November the pool will be required to be at or below elevation 707.8. The additional 58,000 acre-feet of flood control storage would be available until 1 March, then refilling would begin and would usually be completed by 1 April.

3. a. Environmental Impacts. The proposed action would provide additional flood protection in the Skagit River flood plain below Concrete by decreasing peak discharges over those now experienced. Flood frequencies would remain unchanged in areas protected by low levees; however, for major floods, the extent of flooding would be less. Environmental impacts associated with the project are expected to be minimal. As a flood threat would still remain, human occupation and development of flood-plain lands are not expected to increase significantly. Existing state laws and Federal policies governing development in flood hazard areas would still apply to lands within the 100-year flood plain. Costs of flood related community services should decrease somewhat. Agricultural

development of lands is not expected to increase because of greater flood protection. Other intangible effects include reduced probability of accidental death or injury due to flooding; and increased economic security of those now living within the flood plain.

b. Adverse Environmental Effects. Reservoir drawdown of about 12.8 feet from current flood control pool (elevation 720.6) will occur during the typical wet month of November, exposing additional shoreline earlier than in the past, thereby increasing the potential of erosion of lakeshore lands. Although this may create additional problems with lake siltation and turbidity, these problems are not expected to be great. Increased flood protection may create a false sense of security toward the remaining flood hazard. To the extent that this additional security results in increased flood-plain development, greater personal and economic losses could occur. Because of the increased use of Upper Baker Dam facilities for flood control, some net power losses will occur in the future. These losses are small when compared to the total production in the Bonneville system. However, net losses which do occur will be experienced during the winter season when peak energy demand is at its highest, thereby contributing to a small degree to anticipated future power shortages forecast for the Pacific Northwest. The small amount of power production foregone by implementing the proposed action would contribute cumulatively to future power shortages which may justify construction of new generating facilities.

Replacement power will be provided from the Pacific Northwest Federal hydroelectric system to Puget Power through power in kind transferes by the Bonneville Power Administration (BPA). Revenues foregone by the BPA as a result of power transfer would be considered a nonreimbusable Federal flood control cost, to be deducted each year from the reimbursable (power) operation and maintenance account of the Chief Joseph Dam, Lake Rufus Woods, Washington, project. In this way, BPA will be compensated for the Federal power revenue forgone.

4. Alternatives. Alternative 1 - Do Nothing; Alternative 2 - Flood Plain Management Alone; and Alternative 3 - Flood Plain Management with Additional Flood Control Storage at the Upper Baker Project. In addition, variations of the proposed plan were studied and are discussed in this statement.

5. Comments Received Draft Environmental Statement. Copies of the draft environmental statement were sent to some 32 agencies and possibly interested parties on 26 February 1975. An announcement of availability was sent to other interested parties on 21 February 1975. A news release was sent to the media on 19 February 1975 stating the availability of the draft environmental statement. Written comments were requested from the following agencies, groups and individuals. Those commenting on the draft EIS are marked with an *.

89-260 O - 77 - 19

a. National

*Federal Power Commission
Office of Economic Opportunity
*United States Forest Service
Federal Highway Administration
*Environmental Protection Agency
Federal Energy Office
National Marine Fisheries Agency
*Department of Commerce
*Department of the Interior
*Department of Housing and Urban Development
*Fish and Wildlife Service
*Advisory Council on Historic Preservation
*Bureau of Reclamation
*Department of Agriculture

b. State

*Office of Program Planning & Fiscal Management
*State of Washington
University of Washington
Small Towns Institute
Office of Community Development
Puget Sound Air Pollution Control Agency
Eastern Washington State College
*Western Washington State College, Huxley College

c. Local

*Skagit Regional Planning Council
Watcom County Planning Department
Port of Skagit County
Skagit County Public Library

d. Others

Washington Ecological Commission
Friends of the Earth
Mrs. Stanley Engle
Mr. John W. Slipp
Ms. Nancy Thomas
Sierra Club
*Audubon Society
Association of Northwest Steelheaders
Ms. Liz Greenhagen
*Washington Environmental Council

6. Comments Received, Revised Draft Environmental Statement. The revised draft environmental statement was circulated for comment to Federal departments and the State of Washington in March, 1976.

Information copies of the revised draft were sent to parties which had received the draft environmental statement. Copies were also sent to those requesting them.

The following list is of parties that responded in writing to draft environmental statement. Those commenting on the revised draft other than to acknowledge their concurrence are marked with an asterik (*). Copies of original letters and comments/responses are found in section 9.0.

Washington State Department of Ecology
Department of Transportation, U.S. Coast Guard
Environmental Protection Agency
Federal Power Commission
Department of Commerce
Department of Agriculture
Department of Health, Education, and Welfare
*Department of Interior

7. Draft Statement Submitted to CEQ on: 10 February 1975
Revised Draft Statement Submitted to CEQ on: 19 March 1976
Final Statement Submitted to CEQ on: _____

UPPER BAKER LAKE FLOOD CONTROL
STORAGE PROJECT, CONCRETE, WASHINGTON

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1.0 Project Description

1.1 The Baker River, (Plate 1) a tributary of the Skagit River is located in the northwest portion of the State of Washington and traverses Whatcom and Skagit Counties. The Baker River originates in the glaciers of Mount Challenger, in the Picket Range east of Mount Baker and Mount Shuksan. It flows mostly southwest and enters the Skagit River at the town of Concrete, Washington.

The Upper Baker Hydroelectric Project, (Plate 2) completed in June 1959, is owned and operated by Puget Sound Power and Light Company. It is located about 8 miles above Concrete and involves a drainage area of 210 square miles. The reservoir, formed by a concrete gravity dam with a spillway crest elevation of 694 feet, provides a usable storage of 220,630 acre-feet between normal maximum pool elevation of 724 feet and minimum operating pool elevation of 655 feet. Its dead storage, below elevation 655 feet, is 64,800 acre-feet. The surface area of Baker Lake at normal maximum pool elevation is 4,985 acres. The pool elevation is now held below 720.6 feet during the winter flood season to provide 16,000 acre-feet of flood storage required by the Federal Power Commission as replacement for natural valley storage lost when the Baker Lake reservoir was created. Maximum drawdown from normal full pool is 69 feet. However, the maximum normal drawdown is usually less than 50 feet. Baker Lake usually is lowered to elevation 700 feet by mid-January and sometimes as early as mid-December due to the need for hydroelectric power generation. The installed nameplate capacity of the project is 94,400 kW.

1.2 Proposed Action. The Seattle District, U.S. Army Corps of Engineers, has selected Alternative 3, Flood Plain Management with additional Flood Control Storage at Upper Baker Project shown on page 49 of this document, as the recommended plan. Alternative 3 proposes that up to 58,000 acre-feet of additional flood storage space at the Upper Baker reservoir be provided during the winter flood season by holding the reservoir below elevation 707.8 feet, except when actually controlling a flood. Provisions for this additional flood storage are included in the terms and conditions of the project's Federal Power Commission (FPC) license. This additional storage would be available during the flooding period from 15 November to 1 March of the following year, with the additional drawdown for flood control to begin on 1 November of each year. Following the flood control storage period, reservoir refilling can begin with refilling target date 1 April (see figure 1). However, as the refill depends on weather, snowpack, rainfall and power load, refilling in some years might be completed later than the target date. No reservoir drawdown for flood control is contemplated during the summer season.

Flood-plain regulation by Skagit County is included in this alternative. Federally subsidized flood insurance is now available to Skagit County residents. Under the proposed plan of operation with additional flood control storage, space at Upper Baker Project would be utilized to increase protection to the lower Skagit area during major floods. Flood control regulation would begin when unregulated flow on the Skagit River at Concrete is forecast to exceed 90,000 c.f.s. Some minor flooding which is known to occur at lesser flows would not be affected by flood control regulation at Upper Baker project. However, the level of protection to the city of Mount Vernon would be increased such that safe channel capacity in this area would be exceeded an average of about once in 15 years rather than once in 10 years without Upper Baker storage. For 10-, 25- and 50-year floods, the discharge at Mount Vernon will be reduced by about 12,000, 15,000 and 18,000 c.f.s. respectively. Although the severity of flooding will be reduced, the duration of the flood will be slightly increased as the stored floodwaters are released from the Upper Baker project after the river has peaked. For example, a flood under existing conditions that takes a total of 48 hours to recede below the zero damage level would take approximately 56 hours with the Baker Lake Storage project in operation.

The flood protection offered by the proposed action is in agreement with Skagit County's flood plain management objectives as outlined in the Comprehensive Land-Use Planning Alternatives for the Skagit River Flood Plain and Related Uplands, prepared by the Skagit Regional Planning Council, April 1973. This subject is discussed in greater detail in section 3 of this environmental impact statement.

1.3 Project Authorization. Studies conducted of additional flood control at Upper Baker Project were in follow-up to the Comprehensive Water and Related Land Resource Study of Puget Sound and Adjacent Waters, Washington. The comprehensive and detailed project feasibility studies were authorized by the Flood Control Act of 1962, Section 209, Public Law 87-874. The comprehensive study, initiated in 1964 and completed in 1971, identified early action needs of the Puget Sound area for water and related land resource preservation, conservation, and development. Additional flood control storage at the existing Upper Baker River project, constructed by Puget Sound Power and Light Company (Puget Power) in the interest of hydroelectric power generation, is an early action element of the comprehensive plan. The comprehensive plan was submitted to Congress by the U.S. Water Resources Council through the President's Office of Management and Budget in July 1974.

1.4 Project Benefits and Costs. Average annual flood damages without the project for a 100-year period 1977-2077 are estimated at $4,766,000. Of this amount, the proposed flood control project would prevent annual damages estimated at $1,127,000. Estimated annual costs for

the flood control project include interest charges, annual costs of operation and maintenance, and costs of replacement of an equivalent amount of power because of the use of a portion of Upper Baker storage for flood control purposes rather than power generation.

An interest rate of 5-7/8 percent and an analysis period of 100 years have been used in the projection of benefits and costs. Annual charges and benefits are listed below:

Average Annual Benefits	100 Year Analysis
Flood damage reduction	$1,127,000
Average Annual Costs	$434,000
Benefit/Cost Ratio	2.6 to 1

2.0 Environmental Setting Without the Project

2.1 The Baker River, from its start in the glaciers of Mount Challenger in the Pickett Range, flows southwest to its confluence with the Skagit River at Concrete, Washington. The Baker drains some 298 square miles, and has a mean annual flow of 2,663 c.f.s. at Concrete, Washington. Maximum flood of record occurred on the Baker in 1962, with a flow of 36,600 c.f.s. Rocky, Sulphur, Boulder, and Park Creeks, which originate on the east slopes of Mount Baker, and Swift Creek, originating from the west side of Mount Skuksan, are the major tributaries to Baker River.

2.2 The Skagit River, with its principal tributaries of the Sauk, Baker, and Cascade Rivers, and Thunder Creek, comprise the major waters of the Skagit-Samish River basins. The Skagit River originates in Canada, flows southwesterly about 163 miles to Skagit Bay on Puget Sound draining 3,105 square miles, including 400 square miles in Canada. Maximum flood of record for the Skagit occurred in November, 1909, with a peak discharge of 260,000 c.f.s. at Concrete, and 220,000 c.f.s. at Sedro Woolley.

2.3 The Skagit Basin is bounded on the north by the Nooksack-Sumas Basins and Canada, on the south by the Stillaguamish and Snohomish Basins, on the east by the crest of the Cascade Mountain Range, and on the west by Samish, Padilla, and Skagit Bays, arms of Puget Sound.

2.4 The Skagit flood plain includes the entire floor of the Skagit River valley, the deltas of the Samish and Skagit Rivers, and reclaimed tidelands. The almost 100,000 acres of flood plain below the Baker River includes a broad delta downstream of Sedro Woolley. The valley upstream from Sedro Woolley is narrow and relatively undeveloped although farms and vacation cabins are scattered along the flood plain. In this Upper reach, about two-thirds of the bottom land is uncleared or occupied by river channels and sloughs. The valley varies in width from less than 1 mile in the upper reaches to about 2 miles at Sedro Woolley, then opens into a broad delta outwash plain more than 15 miles wide (plate 1).

2.5 Existing Flood Control. Presently, there are seven dams located on the Skagit River System. Ross, Diablo, and Gorge on the Upper Skagit River are owned and operated by Seattle City Light. The Upper and Lower Baker River Dams are owned and operated by Puget Sound Power and Light Company. The Lone Star Cement Company owns two small power dams on Bear Creek; however, these structures are no longer in operation.

The Ross and Upper Baker Dams and Reservoirs in conjunction with channel improvements and a levee system are the only structures providing flood control for the Skagit River basin. Ross Dam controls about 30 percent of the basin's runoff with 120,000 acre-feet of

storage space reserved for winter flood control. The Upper Baker Reservoir has a flood storage capacity of 16,000 acre feet as required by its FPC license to compensate for natural channel storage lost by construction of the dam. The Baker River dams do not contribute to dependable flood control beyond the 16,000 acre-feet reservation. Flooding recurrence of the Skagit River under present conditions with exisiting flood control projects can be expected to occur on an average of every 3 years.

2.6 Developments in the flood plain include all or portions of the towns of La Conner, Conway, Mount Vernon, Burlington, Sedro Woolley, Hamilton, Rockport, and Marblemount.

2.7 Geologic Setting. The mountainous region of the Upper Skagit Basin consists of ancient metamorphic rocks, largely phyllites, slates, shales, schists and gneisses together with intrusive granitic rocks and later andesitic lavas and pyroclustic deposits associated with Mount Baker and Glacier Peak. The valleys are generally steep sided and frequently flat floored. Valley walls are generally mantled with a mixture of rocky colluvium and to considerable elevation by deposits of continental and alpine glaciation. These deposits are a heterogenous mixture of sand and gravel together with variable quantities of silt and clay depending on mode of deposition. The valley floor flood plain of the Skagit below Concrete is composed of sands and gravels diminishing to sands silts and some clays downstream. Below Hamilton, fine grained flood plain sediments predominate. The valley of Baker River in the vicinity of the reservoir is geologically significantly different from most of the other Skagit tributaries. This is largely due to the influence of Mount Baker and volcanic cone rising to elevation 10,778 feet immediately northwest of the valley. The last dated major eruption, about 10,000 to 12,000 years ago, poured a lava flow down Sulphur Creek blocking the Baker Valley. Subsequent cutting of the narrow canyon through this lava flow provided the site for the Upper Baker Dam. Subsequent volcanic activity, as recent as 200 years ago, has resulted in flows of hot ash, debris and mud being discharged down tributary valleys into the Baker Valley. The result is a variable mantle of volcanic pyroclastic and debris flow materials overlaying glacial deposits on the west side of the valley. Evidence of continued volcanic activity is seen in an increase in geothermal activity in the summit crater early in 1975. The east side of the reservoir largely consists of a mantle of glacial deposits and colluvium over slates and shales. Some of the glacial deposits are silts and sands deposited in a glacial lake environment.

2.8 Vegetation. The upper Skagit Basin is forested predominately with dense stands of conifers typical of the Western Cascades and includes Douglas fir, mixed with cedar and hemlock. A portion of the lower basin lies within the boundaries of the Mount Baker-Snoqualmie National Forest, while the upper basin is within the North Cascades National Park. The lower elevations of the Skagit valley are forested primarily by red alder, cottonwood, and maple. The understory

consists primarily of vine maple and other shrubs, vines, and herbs, with salal, huckleberry, trailing blackberry, thimbleberry, boldhip rose, salmonberry, snowberry, broken fern, sword fern, and Oregon grape occurring in the more open areas.

2.9 The climate of the Skagit Basin is classified as midlatitude, West Coast, marine. Due to its location on the windward slopes of the Cascade Range, the area around Baker Lake is dominated by marine influences throughout the greater part of the year. The climate is characterized by heavy rain and snow during the late fall, winter, and early spring. The average annual snowfall varies from 525 inches at Mount Baker lodge to 5.6 inches at Anacortes. The total annual precipitation varies from 103 inches at Mount Baker lodge to 27 inches at Anacortes, but averages about 45 inches at Sedro Woolley. The average high temperature is 60° F and the average annual low is 41° F. The mean length of the growing season is 193 days.

2.10 Fisheries and Wildlife Resources. The Baker River drainage includes the Baker River, Lake Shannon, Baker Reservoir, and several tributary streams, which along with lands within the drainage area support a wide variety of fish and wildlife. Fish resources of the basin include resident rainbow, cutthroat and brook trout; whitefish, kokanee, and Dolly Varden. Anadromous species include chinook, coho, sockeye, pink, and chum salmon, steelhead and searun cutthroat trout. Rainbow trout, planted in Baker Lake by Puget Power, support a put-and-take type fishery. Kokanee, Dolly Varden, rainbow, and cutthrroat trout are all present in Baker Lake as self-sustaining populations. Kokanee are the most important species present in that they sustain the largest naturally-produced harvest. Dolly Varden are harvested in smaller numbers but achieve "trophy size" and are specially sought after by some anglers. Self-sustaining rainbow and cutthroat populations are small and contribute little to overall harvest. Puget Power, in cooperation with Washington Department of Fisheries, maintains an anadromous fish collection facility at Concrete. During the 1972-73 collection period, nearly 14,400 salmon were captured, trucked, and released into Baker Lake and adjoining artificial spawning beaches. They consisted of 10,000 sockeye, 4,000 coho, 250 chinook, and 30 chum. In addition, 50 steelhead trout were captured and released. The Washington Department of Fisheries maintains artificial spawning beaches at the mouth of Channel Creek at the upper end of the reservoir. These beaches provide spawning habitat for 3,000 sockeye salmon to make up for the natural spawning lost as a result of construction of Upper Baker Dam. To pass juvenile fish downstream, the Baker project uses a fish attraction barge, which starts operation in March. Puget Power also maintains a trout stocking program to enhance Baker Lake sport fishing.

The waters of the Baker drainage are extremely clean and provide an excellent habitat for fish rearing. Little rock flower from melting glaciers enter the Baker River, since the glaciers feeding it lie on the east side of Mount Baker and receive little direct

sunlight during the hot summer months. The spawning provided by Baker Lake tributaries and artificial spawning beaches contributes to the sport and commercial fisheries of the Pacific Ocean, Puget Sound, and the Skagit River. Although Baker Lake provides an excellent environment for fish rearing, sockeye salmon spawning in lake areas is usually not successful because of receding lake levels. Fish prefer spawning areas in tributary streams. Table 1 gives fish landings and value of the catch in 1973 (the most recent data available) for sport and game fisheries in the Skagit River:

TABLE 1
FISHERIES AND WATERFOWL

	Specie	Number of Fish Caught	Unit Value	Total Value
Sport fishery:				
	Chinook	1,881	$20	$37,620
	Coho	1,161	20	23,220
	Pink	9,255	20	185,100
	Jack(1 & 2 yr. old Chinook or Coho)	1,655	20	33,300
	TOTAL	13,962	20	$279,240
Game fishery:				
	Steelhead	16,729	$80	$1,338,320

SOURCE: Washington State Department of Fisheries.

Comparable figures are not compiled for other resident game fish such as trout, whitefish or Dolly Varden.

The only commercial fishery on the Skagit River is an Indian fishery which began in 1974. Table 2 gives fish landings and value for this fishery:

TABLE 2

Specie	Number of Fish Caught	Unit Value	Total Value
Chinook	1,433	$19.42	$27,829
Chum	4,573	11.09	50,715
Sockeye	729	5.77	4,206
Coho	8,306	8.67	72,013
	15,041		$154,763

SOURCE: Washington State Department of Fisheries.

The chief big game mammals of the basin are elk, deer, black bear, mountain goat, and cougar. Deer, and occasionally black bear and cougar, occupy the lowlands. Rabbits and snowshoe hare are the common small game mammals, and mink, muskrat, otter, beaver, marten, weasels, skunks, bobcat, fox and coyote are the common furbearers. Numerous other mammals commonly found in the basin include raccoons, porcupines, opossums, squirrels, chipmunks, moles, voles, shrews, mice, and bats.

The chief upland game birds of the basin are blue, ruffed, and spruce grouse, and band tailed pigeon. Waterfowl are numerous, but are much more prevalent in the lower basin. Waterfowl species include mallard, bufflehead, scoup, ruddy, widgeon, swans, ducks, and Canada and snow geese. Numerous species of song birds, shore birds, and raptors are also present. Some of the more notable raptors are bald and golden eagles, osprey, red-tailed hawks, and great horned, barn and shorteared owls. In addition, it has been reported that Osprey nesting occurs near the east shore of Baker Lake, near Silver Creek. Table 3 gives number of waterfowl caught and value for the Skagit River-Baker Lake area for 1973, which is the most recent information available:

TABLE 3

Specie	Number of Waterfowl Caught	Unit Value	Total Value
Duck	114,170	$11.58	$1,322,089
Geese	5,160	11.58	59,753
TOTAL	119,330	$11.58	$1,389,842

SOURCE: Washington State Department of Game.

Reptiles and amphibians include western gartersnake, several species of lizards, tailed and northern tree frogs, and several species of salamanders.

Recent steam venting activity on Sherman Peak, west of Baker Lake, may be causing increased acidity levels in Boulder Creek, a tributary for Baker Lake. Recent water quality studies taken at the mouth of Boulder Creek by the U.S.G.S. revealed a pH reading of 3.5, or highly acidic, whereas most streams in the Baker Lake area yield readings of 6.5 to 7.0, or neutral to slightly alkaline. Water with a pH of 3.5 can be compared to vinegar.

Although waters with such high concentrations of acid are lethal to fish and other aquatic organisms, Forest Service personnel report that there has never been evidence of fish production in Boulder Creek. Personnel from the Washington State Department of Game report that the impacts of Boulder Creek water to fishery production in Baker Lake are probably minimal or nonexistant. This is attributed to greater levels of dissolved minerals in Baker Lake waters, thereby acting as a buffer to acid entering it.

2.11 Historical and Archeological Significance. There are no nationally recognized historical sites on lands surrounding the project area. 1/ There are no known archeological sites in the vicinity and because the elevation of the lake would not be increased by the proposed modification, no archeological field studies are contemplated.

2.12 Recreation. Recreational development around Baker Lake includes four developed Forest Service campgrounds and 12-14 undeveloped sites, a Puget Power campground, and a commercial resort. Puget Power and the Forest Service estimate that 222,000 people visited the Baker River drainage area during 1972. Although Puget Power's developed campground was not officially open during 1972, it was full of campers nearly every weekend throughout the summer months.

Skagit County is a popular tourist and recreational attraction as well. Along with other counties in northwestern Washington State, it shares the impressive Cascade Mountain Range. Portions of the North Cascades National Park and the Glacier Peak Wilderness are located in eastern Skagit County, and the principal access is through the Skagit River valley. Its economic potential has yet to be realized, but the recent completion of the North Cascades Highway, which opened hitherto inaccessible natural attractions, should be a major stimulant to tourist and recreational activity in the county.

In addition, the Skagit River itself, famed for steelhead fishing, and the position of Skagit County as the point of departure by ferry (from Anacortes) to the San Juan Islands make the county important to vacationers. The islands of Skagit County, which include Fidalgo, Guemes, and Cypress, are a part of the San Juan archipelago. Fidalgo Island, connected by a bridge to the mainland, has experienced considerable recreational development in the past decade with land and marina development at Skyline representing a major investment.

For the most part, however, the potentials for Skagit County tourist and recreation have not been developed, but given the rural character of this region and its impressive natural endowments, the opportunities for future development are considerable.

Baker Lake is a popular and much used fishing area. The 1971 Baker Lake Creel Census, taken from 1 July to 6 September 1971 reported on estimated catch of 9,826 rainbow trout from a plant of

1/National Register of Historical Places, Federal Register, Tuesday, February 19, 1974, Volume 39, November 34, Part 11, p. 6477; and personal communication with Mr. David Hansen, Washington State Office of Archaeology and Historic Preservation, 15 May 1975.

55,000 catchable-size fish, 10,658 Kokanee and 1,524 miscellaneous species. This total catch of 21,998 fish represented some 25,538 man hours of fishing during the census period, with the average angler fishing about 2.94 hours. The census further estimated that 2.73 fish were caught per fishing trip, with 1.21 rainbow and 1.40 Kokanee average catch per trip.

2.13 Land use with associated water requirements in Skagit County changes from sparsely habitated in the area around Baker Lake and associated uplands, to scattered structures in agricultural areas, to moderately intense urbanization on the valley floor. The primary land use is forests, with about 90 percent of the total county put to this use. Agriculture and urban land uses occupy 5 percent and 1 percent of the land, respectively.

Table 4 below displays the general land use pattern by activities for the majority of Skagit County.

TABLE 4 1/

Use	No. of Units	Percent of All Units	Acres	Percent of Acres
Residential	15,565	89	9,488	1.71
Community	322	1	1,052	.18
Commercial	1,249	7	814	.44
Industrial	220	1	954	.17
Transportation	--	--	6,483	1.17
Forest	--	--	426,088	77.10
Agriculture	--	--	106,760	19.31
Parks	--	--	955	.17
Totals	17,336	100	552,595	100.

1/Data conforms to the Skagit River flood plain and related uplands (east of the Swinomish Slough). Data obtained from: Comprehensive Land Use Planning Alternatives for the Skagit River Flood Plain and Related Uplands, Skagit Regional Planning Council, Mount Vernon, Washington, April 1973.

Continued development of the county is expected, especially by construction of residential housing.

2.14 Housing. The following summary of housing characteristics for Skagit County is based on information presented in Comprehensive Land Use Planning Alternatives for the Skagit River Flood Plain and Related Uplands, 1973. Of the 19,575 dwelling units located in Skagit County in 1970, 17,185 (approximately 88 percent) were occupied. The average value of the owner-occupied units was $17,775. The average monthly rental was $76. Approximately 89 percent of the dwelling

units were classified as sound; approximately 8 percent were classified as deteriorating; and approximately 3 percent were classified as dilapidated. There are 716 mobile homes used as dwelling units within the county. The Skagit Regional Planning Council predicts that within the next 20 years approximately 2,084 new dwelling units (10.6 percent increase) will have to be constructed.

Within the flood plain area, the single-family dwelling unit is the primary residential structure. This trend is expected to continue unless altered by one or more of the following factors: (1) increased use of mobile homes as permanent residential structures; (2) expanded development of multifamily residential structures; and (3) the increased use of planned unit development versus conventional subdivisions. All future home construction within the 100-year flood plain will be subject to the Washington State Flood Control Zone of 1975. As land prices escalate, it can be assumed that there will be increased use of high density developments. However, the offsetting factor in the flood plain area is the seeming abundance of vacant and hence potentially developable land. There will most likely be a slow continuation of the diversification of housing types within the flood plain. Demand for rural and ranchette as well as townhouses and garden apartments is expected to continue, especially near urbanized areas, and lakes and shorelines within the flood plain.

Flooding in this area adversely effects the quality and dollar value of housing available. Floodwaters rarely carry entire houses off their foundations; however, significant damage such as shifting and settling of foundations, damp rot in timbers, buckling of floors and walls, shorting of electrical systems, rusting of tools and appliances, and the soiling of furniture, rugs and draperies often results from flooding. The home owner must spend funds which might have otherwise gone for home improvements on costly flood damage repairs.

2.15 Socio-Economic Characteristics. The Skagit Basin's econony may be typified as essentially resource oriented. There are no significant major employers in the commercial, industrial, wholesale, or retail facilities in the county. Agriculture, logging, and fishing industries, the "mainstays" of the economy, have either been stagnant in terms of employment or have declined. The service sectors of the economy, however, have shown employment gains; most notably in the trade and government services sectors. The following paragraphs treat the socioeconomic environment in detail.

2.16 Population. Although Skagit County has grown in past decades, the rate of growth in recent years has been slower than that of counties in the central part of Puget Sound. Population trends for the basins and its cities and towns are shown in table 5.

TABLE 5

Population Trends

Area	1940	1950	1960	1970	% Change 1940-1970	Annual Average Change 1940-1970
Skagit County	37,650	43,270	51,350	52,380	38%	1.1
Anacortes	5,880	6,920	8,410	7,700	31%	0.9
Mount Vernon	4,280	5,230	7,920	8,800	105%	2.4
Sedro Woolley	2,950	3,300	3,700	4,600	56%	1.5
Burlington	1,630	2,350	2,970	3,140	95%	2.2
Concrete	860	760	840	570	-33%	(-1.4)

Figures from U.S. Census Reports.

The county on a whole increased its population from about 38,000 in 1940 to about 52,400 in 1970, a gain of about 38 percent. Over the period 1960-1970, the population increased by over 1,000, representing an average annual increase of about .2 percent. In 1970, 46 percent of the population was classified as urban while 53 percent maintained a rural type of existence, representing a 10 percent increase in the urban population since 1950, and a 10 percent decrease in the rural population over the same time period. The most notable features of population migration for the basin are seen in a persistent pattern of out-migration of young adults and the unpredictable in-migration of agricultural labor during the summer harvest seasons. Population projections completed by the Skagit Regional Planning Council indicate that the Skagit Basin will continue to grow at a leisurely pace in the future, with projections ranging from .2 percent to 1.0 percent per year.

Of the total 1970 Skagit County population, 98.1 percent was white. The nonwhite total increased only slightly from the previous decade and has deviated only .4 percent since 1940. Out of the total 1970 minority population of 1,011, 650 were American Indian, 182 were Mexican-American, 134 were Oriental, and 45 were Black.

The average age of the population of Skagit County has increased in the last decade (1960-1970), while the number of children under 5 years of age has decreased. This is probably attributable to the declining birth rate. Of the total county population, 35 percent is over 45 years of age. Only 29 percent of the state population is over 45 years of age. The recent decrease in the ratio of younger county residents to older may have contributed to the decrease in the rate of population growth for the county.

There has been a slight increase in the number of deaths in Skagit County over the last 10 years, due largely to the increased numbers of older people being attracted to the county because of its popularity as a retirement community.

Past records of net migration, indicating the balance between migrants in and migrants out, further explain the recent slowing of population growth in Skagit County. Between 1940 and 1950 the county experienced a net migration of 3,348 people. Between 1950 and 1960 there was also a plus net migration of 2,269. However, between 1960 and 1970 Skagit County experienced a net migration of minus 2,271. This loss of population to other areas over the past decade is probably due to the attraction of employment opportunities elsewhere compared to those available in the fairly static agriculture and extractive resource base of Skagit County.

It is difficult to do more than speculate as to impact of flooding on past and future net migration. Although the 1951 flood caused the most extensive and severe damages experienced by communities within this flood plain over the last 52 years (see page 40), there is no indication of a resulting outmigration for either the county or the incorporated communities directly affected. However, the current low level of flood protection may discourage inmigration because of the constraints it presents on new developments.

Although the threat of a flood may not entirely discourage new development of areas within the flood plain, it does limit the amount of attractive adjacent land available to a community for expansion. Communities which are located entirely within the flood plain such as Hamilton are less likely to attract new residents than those only partially within the 100-year danger zone such as Sedro Woolley.

2.17 Employment. Employment by industry sectors is shown in table 6 for 1958 through 1971.

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TABLE 6

LABOR FORCE AND EMPLOYMENT IN SKAGIT COUNTY FOR SELECTED YEARS

	Annual Average			
	1958	1963	1968	1971
Civilian Labor Force	21,090	19,460	21,790	23,340
Unemployment	2,050	1,650	1,610	3,160
Percent of Labor Force	9.7	8.5	7.4	13.5
Employment	19,040	17,810	20,180	20,180
Agriculture	3,280	2,780	3,380	3,280
Non-Agricultural	15,750	15,030	16,800	16,900
Employer, own account, unpaid, and domestics	2,910	2,970	3,000	2,970
Wage and Salary Workers, Non-Agricultural	12,840	12,060	13,800	13,920
Total Manufacturing	3,760	4,070	4,280	3,510
Food and Kindred Products	1,090	1,060	1,020	670
Lumber and Wood Products	1,200	1,330	1,360	1,210
Printing, Publishing, and Allied Industries	80	90	70	--
Stone, Clay and Glass Products	140	150	190	80
Miscellaneous Durable Goods 1/	350	530	650	540
Miscellaneous Non-Durable Goods 2/	900	910	990	1,010
Forestry, Fishing, Mining, and Miscellaneous	170	220	150	180
Contract Construction	1,900	630	770	860
Transportation, Utilities, and Communications	750	670	650	670
Wholesale/Retail Trade	2,320	2,210	2,820	3,070
Finance, Insurance, and Real Estate	290	310	360	420
Services	1,240	1,150	1,330	1,450
Government	2,410	2,800	3,440	3,760
Educational Services	840	1,060	1,300	--
All Other Government	1,570	1,740	2,140	--

1/Includes fabricated metal products, machinery, transportation equipment, and other durable goods manufacturing.

2/Includes chemicals and allied products, paper and allied products, petroleum refining, and other nondurable manufacturing.

Source: Washington State Employment Security Department.

The basic activities in the county, agricultural and processing of agricultural products, forestry, and lumber production, and in much smaller numbers fishing, mining and petroleum refining, are reflected in the employment distribution. Also significant but not separately identified is the amount of employment generated by the recreational and tourist industry. Over the past decade, employment in Skagit County has grown slowly, certainly not rapidly enough to provide job opportunities commensurate with an expanding population. Compared to Washington State's civilian labor force in 1970, Skagit County's labor force was a smaller percentage of total population (37.7 percent), composed of more males (64.6 percent) and had a lower median family income ($9,407). Generally, the economic status of the county is below that of Washington State. Despite net out-migration of population, unemployment rates in Skagit County have been high throughout the decade. The best year was 1968 when the unemployment rate was as low as 7.4 percent. Contributing to high unemployment rates is the seasonal nature of the basic industries, but rates of unemployment in recent years (1973 average was 10.1 percent) reflect depressed market conditions as well as a tendency for population growth to outrun the creation of new jobs. In August of 1973, Northern State Hospital in Sedro Woolley was closed and thus eliminated employment of its average work force of 650. This contributed to a recent increase in the county unemployment rate of 13.1 percent 1/ in April 1974.

Agricultural employment, the "main-stay" of the county economy, has been declining over recent years, in line with national trends. Within manufacturing, employment in food processing and stone-clay-glass has declined sharply, reflecting closure of the cement plant at Concrete in 1969, but employment in lumber and wood products has maintained its levels. There have been significant increases in employment in nonmanufacturing jobs, particularly in trade, Government, and services. However, total employment in Skagit County has grown only 6 percent during the past decade, in contrast to an increase of 26 percent statewide.

2.18 Income. Total personal income, an indicator of the magnitude of economic activity in an area, was $204.1 million in 1971 in Skagit County. This represented a 263 percent increase from the 1950 total of $56.3 million, an average annual increase of 3.6 percent when converted to constant dollars. The State of Washington experienced a smaller increase of 259 percent during this same time period. In 1971, Skagit County contributed 1.4 percent of the total personal income in Washington State, and this percentage has remained constant since 1950. In 1971, per capita personal income for Skagit County was $3,859, a 198 percent increase over the $1,297 attained in 1950. The state registered a 149 percent increase in per capita personal income from 1950 to 1971. In 1971, per capita income in Skagit County was $310 below that for the state. Table 7 shows total personal

1/Washington State Employment Security Department.

TABLE 7

TOTAL PERSONAL AND PER CAPITA PERSONAL INCOME FOR
SKAGIT COUNTY - 1950, 1965, 1970 and 1971

	Total Personal Income (millions of current dollars)					Per Capita Personal Income (current dollars)				
	1950	1965	1970	1971	Percentage Change 1950-1971	1950	1965	1970	1971	Percentage Change 1950-1971
Washington	$3,995.0	$8,652.0	$13,730.0	$14,349.0	259%	$1,674	$2,616	$4,022	$4,169	149%
Skagit County	56.3	132.1	188.0	204.1	263%	1,297	2,682	3,585	3,859	198%
Skagit County as a percent of Wash.	1.4%	1.5%	1.4%	1.4%	-	77%	103%	89%	93%	-

Source: U.S. Department of Commerce, Computer listing of Total and Per Capita Personal Income for SMSA's and non-SMSA Counties of Washington; U.S. Department of Commerce, Survey of Current Business, August 1973.

income and per capita personal income for the state and county for the years 1950, 1965, 1970 and 1971.

Skagit River flooding appears to have only a minimal impact on the employment and income of flood-plain residents. Temporary unemployment may occur during or shortly after flooding, until recovery operations have been completed.

2.19 Population, Employment and Income Projections. Future economic growth in Skagit County should remain below that of Washington State. Per capita incomes should also be below the State average due to the seasonability of the dominant industries in the county - agriculture, food processing and lumber and wood products.

The Skagit Regional Planning Council has projected future population growth to continue much as it has in the past with long-range estimates (20+ years) varying between .2 to 1.0 percent per year. Given the growth potential for Skagit County in the fields of tourism and recreation as a complement to its agricultural-extractive resource base, it is not surprising that the principal components of economic growth projected are in finance, services and related activities. Over the 100-year study period, the largest absolute increases in Skagit County employment are expected in the trade, finance, service and Government sectors.

The areas within the Skagit River flood plain expected to be most affected by the projected county population increase are Mount Vernon, particularly eastward, and Sedro Woolley. The Skagit Regional Planning Council feels that the direction of future growth in the flood plain will be largely determined by the extent to which local officials implement such flood-plain management measures as agricultural zoning, 1.0 acre minimum lot restrictions, and flood zone restrictions. If such planning devices are utilized major portions of the south Skagit flood plain may become less important as extensive residential sites. However, depending upon the degree to which portions of it are not threatened by flood and not limited to agricultural use this area could assume a higher proportion of people in the future. If the planning measures mentioned above are not utilized, the Council expects that areas such as those lying west of Mount Vernon and west of Burlington could grow, causing a split in the agricultural land and increasing the danger of flood damage to both life and property.

The North Cascades Park could stimulate growth in the area near the upper Skagit River. However, it is assumed that this will take place in the form of temporary or second home, rather than permanent full-time residences. Therefore, such growth would probably be only seasonal. The central flood plain including the towns of Hamilton and Lyman, is too far removed from the North Cascades Park to benefit significantly from a tourism increase. This area will probably continue to decrease in population.

2.20 Forest Resources. Forestry continues as a major industry of the Skagit Basin, supporting several large saw mills, two plywood mills, and a pulp-paper mill. In 1960, timber harvest in Skagit County was about 178 million board feet, of which about 84 million board feet came from privately-owned lands. By 1972, log production increased to 297 million board feet, 156 million board feet of which came from privately-owned land. This large increase is attributed in part, to the harvesting of second growth Douglas fir and hemlock on private land. Most of the log cut is moved by truck to pulp and lumber mills in Everett and Bellingham. In Skagit County the "value added by manufacturing" from lumber and wood products manufacturing was $12,100,000 in 1967. Forest resources are relatively unimportant in the Skagit River flood plain.

2.21 Mineral Resources. There are a wide variety of mineral resources in Skagit County, but only a few have been developed commercially. In 1970 the value of mineral production amounted to only $1.4 million, down from the $3.5 million production in 1960. This reduction is the result of a major cement establishment in the town of Concrete ceasing operations in 1969. The principal minerals extracted (in order of importance) currently are olivine, sand and gravel, stone, and soapstone. Very rich deposits of limestone and olivine are found in the upper Skagit Valley, and one of the few commercial strontium deposits in the United States is found near La Conner on Fidalgo Island.

2.22 Agricultural Resources. Agriculture is the leading economic activity in the area, and forage production in support of a dairy industry is the largest type of farming. The rich delta area of the Skagit River accounts for 90 percent of the nation's supply of cabbage seed and about 50 percent of the nation's beet seed, as well as significant amounts of turnip and rutabaga seed. The climate is very mild in the western portion of the county and the land is fertile and highly productive. The bottom lands of the Skagit River flood plain require ditching and diking due to their close proximity to saltwater. Further up the Skagit River the land becomes less fertile and the variety of agricultural products grown is limited. Most of the farms are in the fertile Skagit River delta. The number of farms in Skagit County has been decreasing while the average farm size has been increasing. The total percentage of land in use for farms has been decreasing. Although the amount of lands being farmed has decreased, the market value of all agricultural products sold has increased 65 percent from 1959 to 1969. The market value of all agricultural products sold in 1969 was $26 million. Over half of the total value was from livestock, poultry and their products, followed in importance by crops. Vegetable farming has been increasing, due to pressures for greater and more intensive utilization of land, and there has been a diminution in the numbers of animal stock. Table 8 summarizes some measures of agricultural activity over the past decade. When tidal dikes in the delta are breached, the resulting saltwater intrusion reduces productivity of temporarily inundated areas from

TABLE 8

SKAGIT COUNTY FARM INCOME AND SALES

FOR 1969 AND 1959

	1959	1969
Market value of all agricultural products sold	$15,890,942	$26,234,667
Average value per farm	8,953	24,985
Crops including nursery products and hay	N/A	11,937,541
Specialty forest products	(1964) 83,989	19,696
Livestock, poultry and their products	9,167,984	14,277,430
Value of dairy products sold	(5,550,915)	(8,781,893)
Poultry products sold	(1,575,773)	(1,596,635)
Livestock and livestock products sold other than dairy	(2,041,296)	(1,805,482)
	Head	Head
Cattle and calves	41,160	37,038
Milk cows	16,367	13,274
Hogs and pigs	620	162
Sheep and lambs	1,527	354

Source: Washington State University, College of Agriculture, Skagit County Agriculture: An Economic Mainstay, 1972, p. 4.

1 to 3 years. Existing crops in the flood plain affected by flooding are bulbs, hay, raspberries, strawberries, seed grass, and winter barley. Bulbs contributed to over half of the monetary crop damage caused by past flooding, and in 1969, the market value sold totaled $959,000. Average annual damages of $1,843,000 (1974 prices and conditions), are experienced by agricultural areas within the flood plain. Although acreage devoted to agriculture in Skagit County will probably lessen in the years ahead, the future of the industry is assured by rising productivity and by the proximity of the county to the expanding urban centers around Puget Sound.

2.23 Manufacturing activity in Skagit County is primarily associated with the processing of the natural resource products in the area. Total manufacturing employment was 3,510 in 1971. The principal activities are lumber and wood products and food processing. In constant dollars, value added by manufacturing for Skagit County increased at an annual rate of 3.6 percent between 1958 and 1972 compared to a constant dollar annual increase of 2.7 percent for the state over the same period. Manufacturing of lumber and wood products has been a mainstay of the economy in Skagit County, and in 1970 represented 37 percent of the total manufacturing employment. 1/ The impact of forest products on Skagit County is further indicated in the 1974 edition of the Directory of Washington Manufactures which shows that of the 107 manufacturing firms in the county, 45 percent are in lumber and wood products.

Damaged machinery and business interruptions are the two outstanding types of losses experienced by manufacturing plants due to flooding. Flood waters also damage foundations, superstructures, improvements and decorations of buildings, office furnishings and records, stocks of raw materials and finished goods, outbuildings, vehicles and grounds.

2.24 Retail sales in Skagit County increased at an annual rate of 2.3 percent between 1954 and 1967, when measured in constant dollars. During this same time period, retail sales for the State of Washington rose at an average annual constant dollar rate of 3.3 percent. Mount Vernon, which is partially located in the flood plain, is the center of retail trade for Skagit County and in 1967 accounted for 46 percent of total retail sales for the county. Portions of Mount Vernon and Burlington are located in the flood plain and have experienced rates of growth in retail sales between 1963 and 1967 equal to or slightly greater than that for Skagit County. Retail sales for Washington, Skagit County, Mount Vernon and Burlington are shown in table 9.

2.25 Other Services. The normal complement of community services such as hospitals, nursing homes, a community college, financial

1/Washington State Employment Security Department.

TABLE 9

RETAIL SALES

WASHINGTON AND SKAGIT COUNTY 1954-1967

(1967 $)

	$1,000				Average Annual Increase
	1954	1958	1963	1967	1954 - 1967
Washington	$3,569,789	$3,947,526	$4,408,527	$5,465,566	3.3 %
Skagit Co.	68,578	75,942	79,669	91,917	2.3 %
Burlington	N/A	N/A	9,640	11,094	-
Mt. Vernon	N/A	N/A	35,634	42,397	-
Mt. Vernon as a percent at Skagit Co.	-	-	45%	46%	

Source: U.S. Department of Commerce, Census of Business, 1954, 1958, 1963, 1967.

institutions, libraries, hotels, motels, schools, and churches, are available in Skagit County. As with most other economic activities, the financial and service centers for Skagit County are located in Mount Vernon. A community college, which draws students from all areas of the state is located in Mount Vernon. In 1967, receipts from services totaled $6.5 million in the county, $2.9 million, or about 44 percent in the city of Mount Vernon. As shown in table 10, sales of selected services in constant dollars increased at an average annual rate of 3.6 percent between 1954 and 1967. During this same time period, sales of selected services for the State of Washington rose at an average annual constant dollar rate of 4.9 percent.

2.26 Education in the study area is conducted under the general supervision of Intermediate School District 108 (ISD 108), headquartered in Bellingham. ISD 108 is a four county organization which encompasses the school districts of Whatcom, Skagit, Island and San Juan Counties.

TABLE 10

SELECTED SERVICES

WASHINGTON AND SKAGIT COUNTY 1954-1967

(1967 $)

	$1,000				Average Annual Increase
	1954	1958	1963	1967	1954 - 1967
Washington	$407,962	$504,534	$589,065	$766,956	4.9 %
Skagit Co.	4,101	5,559	6,332	6,519	3.6 %
Burlington	N/A	N/A	377	429	-
Mt. Vernon	N/A	N/A	2,619	2,877	-
Mt. Vernon as a percent at Skagit Co.	-	-	41%	44%	

Source: U.S. Department of Commerce, Census of Business, 1954, 1958, 1963, 1967.

There are a total of 25 schools within the study area; consisting of five high schools, two junior high schools, and eighteen elementary schools. On a rating system ranging from first to third class (with first class signifying the fulfillment of highest reviewing standards), Conway is the only third class district in the study area. La Conner is a second class district and the remaining districts, Sedro Woolley, Burlington-Edison and Mount Vernon are all first class districts. These school districts provided education for a total of 9,764 students in 1970 ranging in level from kindergarten through twelfth grade.

Nearly all public school districts in Skagit County are experiencing a diminishing rate of growth in so far as student population is concerned. This is primarily a result of two unrelated events: (1) birth control is overcoming the cyclic effect of the World War II "baby boom" and (2) there is an outmigration of young adults and their families from the flood plain to other urban centers.

This diminished rate of growth is allowing school districts to reduce student per classroom ratios thus reducing the demand for additional classrooms. Nevertheless, nearly all school districts within the flood plain are near 100 percent capacity and some are presently housed in substandard buildings.

The Skagit Valley College campus covers an area of 85 acres on the northeast edge of Mount Vernon. A Whidbey Island Branch of the college was created in September, 1970, as a cooperative endeavor of the college and the Naval Air Station in Oak Harbor. The Whidbey Branch is located on the Navy Sea Plane Base.

Skagit Valley College is accredited by the Northwest Association of Secondary and High Schools and approved by the Washington State Department of Public Instruction and the Veterans' Administration. The district that the college now serves includes Skagit, Island and San Juan Counties. It is financed by state and Federal funds and by student fees. Total enrollment for the winter quarter of 1973 was approximately 4,200.

Schools within the flood plain lose classroom time during a flood, and the following cleanup period along with the funds which must be appropriated to flood damage repair. Teachers and administrators must also assume responsibility for the students in the event of a severe flood.

2.27 Police and Fire Protection. The Skagit County Sheriff Department is the largest law enforcement agency in the county with a staff of 29 commissioned personnel. It assumes a great deal of the police protection responsibility within the county, including almost all criminal investigative work. Burlington, Sedro Woolley, Mount Vernon and La Conner have city police departments with a total of 33 sworn-in officers. The remaining eight communities within the 100-year flood plain are under the jurisdiction of the County Sheriff Department.

The fire insurance ratings for the six incorporated towns within the flood plain range from four (Mount Vernon) to six, on a scale from 1 to 10; (signifies ideal conditions). The unincorporated towns are rated either seven or eight due to the lack of water supply systems for fire fighting purposes.

In areas threatened by high probabilities of flooding, police and fire departments must answer to increased demand for services under handicapped conditions. Rescue operations during a flood are hampered by inundated roads. Often times there is the threat of looting when people are forced to evacuate homes and businesses. Floods also promote fire by dislodging tanks and spreading oil and gasoline, by hampering the work of fire fighting units, by closing down water pumps, by damaging electrical and heating systems, and by disrupting sprinkler systems.

2.28 Transportation. The Burlington Northern Railroad system serves Skagit County with a Seattle to Vancouver, B.C. mainline through Mount Vernon and Burlington. Another line crosses western Skagit County with facilities in Sedro Woolley. A branch line services the upper valley. Greyhound Bus Lines have a scheduled system with a bus station in Mount Vernon. Interstate 5 is the principal north-south highway. State highways running east and west afford access to all cities and villages within the county. The construction and design of the highways is semi-adequate for present useage according to the Skagit Region Planning Council. State and private roads allow access to the more remote regions.

The majority of aircraft based in this area are light and privately-owned. There is no scheduled air traffic. Local air traffic is of a sightseeing and flight instruction nature, and is greatest during the tourist season. Lower and upper valley landing facilities offer near complete air traffic coverage of the valley. Bay View Airport has the greatest potential for future development as a commercial air traffic operation center.

Barge and freight operations are centered in La Conner and at a sparce assortment of individual industrial locations. Accesses to Puget Sound Ferry systems are through Anacortes and Whidbey Island.

Roads, railroad tracks and air landing strips are often inundated by floods in the study area. The resulting transportation tieup is compounded by an increased number of persons attempting to evacuate the area during a flood and the increased need for supplies and aid units to be transported into the area. Following flooding, interruptions in normal transportation continue while facilities are being repaired.

2.29 Water and Sewage. Essentially all water used for consumption, agricultural, sewage disposal and industrial purposes within the flood plain originates in watersheds located in Skagit County and Mt. Baker -Snoqualmie National Forest. In addition to indeterminable amounts of water from wells, the major source of water is the Skagit River and its tributaries. The average daily flow of water on the Skagit River at Mount Vernon is approximately 10 billion gallons per day. Abundant water is located on or close to the ground surface, making it possible to deliver water throughout the flood plain at nominal cost since neither extensive pumping nor lift stations are required.

According to the 1970 revised edition of the Overall Economic Development Plan for Skagit County, sewage facilities are desperately needed in this area. Existing lines and treatment facilities are presently inadequate to handle existing demands. City and county groups are currently trying to determine how to support the full-time industry required to build adequate sewage systems in this area of low population density and a relatively high tax structure.

During severe flooding municipal or private water supplies may become contaminated due to inundated sewage systems and septic tanks. Until the necessary repairs are made, residences and businesses in the area are without sanitary water supplies and waste disposal facilities. Not only does this interrupt the production of goods and services within the area, it also poses a serious health threat.

2.30 Health Services. Approximately 42 physicians and 28 dentists practice in towns within the flood plain. The majority of these have practices in Mount Vernon with a substantial number in Burlington and Sedro Woolley. Two hospitals service this area. United General Hospital, near Burlington has 98 beds and had an average occupancy 50 percent during 1973. Skagit Valley Hospital has 129 beds and had an average occupancy rate of 68.5 percent in 1973. Both hospitals provide general medical and surgical services including emergency and intensive care.

According to the Skagit County Health Department, flooding has not seriously affected public health in the flood plain area. However, the rushing waters of a severe flood constitute a life-threatening situation. Photographs taken of the 1951 flood damages show farm building which were totally destroyed by flood waters. According to local newspapers, an entire house near Conway was swept off its foundation. No deaths were associated with these events. However, hundreds of residents were forced to temporarily evacuate their homes and take refuge in nearby public and private buildings. The adverse effects of crowding, compounded by the absence of normal sanitary conditions such as adequate cooking, washing and toilet facilities increases the probability of transmitting infectious disease among flood refugees. The ability of hospitals and health professionals to deliver normal health care services is inhibited during flooding by inundated roads and crowded facilities. After cresting, receding floodwaters deposit several inches of mud which dries to dust over the flood plain. This can irritate respiratory ailments for months following.

2.31 Institutional Dynamics. Flood-plain management, flood protection and warning, along with emergency relief involve a number of governmental, volunteer and private agencies ranging from the local to the national level. The following summarizes the interactions of the major concerned institutions with each other and with the flood-plain residents, and how these interactions affect current social economic flood-plain conditions.

The five incorporated towns within the flood plain (Mount Vernon, Burlington, La Conner, Sedro Woolley, Hamilton and Lyman) have mayor-council city governments. Burlington and La Conner have planning councils but contract with the county for the issuance of building permits and building inspection. Sedro Woolley also has a planning commission and issues building permits. Lyman and Hamilton do not have planning commissions. Unincorporated communities within the

flood plain are under county jurisdiction. Skagit County has formal building codes and zoning ordinances.

The city and county governments having jurisdiction over the flood-plain areas contribute significant amounts of time, effort and money to flood related problems. Currently, these government bodies are dealing with flood-plain management measures. During and after flooding, they are involved in assisting in the appropriation and utilization of flood relief funds.

Skagit County presently has a form of flood-plain management through an amendment to the Interim Zoning Ordinance #4081. This ordinance is very similar to State Regulations WAC 508.60 and RCW 86.16 except with reference to flood frequency and floodway concepts. Also, the state regulations prohibit structures used for permanent human habitation, or uses associated with high flood damage potential within the floodway. The County Ordinance does not make such restrictions.

Present state and county regulations raise the cost of new development in the flood-plain area through requirements for flood proofing. By requiring flood proofing, the cost of developing the flood plain is transferred from the public to the private sector.

The Washington State Flood Damage Relief Council was founded in 1934 as the Puget Sound Flood Control Council with the intent of providing a place where common flood related problems could be discussed, information exchanged, and recommendations formulated for presentation to the Legislature for state flood control programs. After renaming the council The Washington State Flood Control Council in 1957, there was a shift in emphasis from structural solutions to other alternative methods in reducing flood damages. This shift was partly due to changes in Federal and state program emphasis on the efforts of individual government agencies to a combined, cooperated effort of all levels of government with the local government taking the initiative in creating long-range flood damage reduction programs. Recommendations made by the council to the Governor and Director of the Department of Ecology suggested statewide planning of flood damage reduction projects, better coordination of local projects and the use of techniques other than structural as a solution to flood damage reduction.

The United States Water Resources Council prepared flood guidelines for Federal agencies in response to Executive Order #11296. These guidelines were published in May 1972. The idea behind the guidelines is not to eliminate all development of the flood plain, but to discourage those developments which: (1) Could cause substantial damage (i.e., gas stations, log dumps), (2) could cause substantial loss to the owner and/or community (small business, county courthouse), and (3) could create a danger to human life

(residential areas). Open space uses could most compatibly exist in high flood frequency locations. These uses may range from outdoor theaters to farmlands. These types of open space uses, with limited permanent investment, are capable of being flood proofed, and do not contribute greatly to down-river damages.

2.32 Flood Characteristics. The Skagit River system produces more runoff than any other river basin in the Puget Sound area. Average annual runoff exceeds 12,000,000 acre-feet per year at the Mount Vernon gage. The Baker River watershed produces an equivalent of 1,929,000 acre-feet per year with an average discharge of 2,660 c.f.s. at the Concrete gage.

The Skagit River and all of its major tributaries usually have low flows during August and September after the snowpack has melted and the ground-water flow has been partially depleted. With the occurrence of heavy precipitation in the fall and winter, the rivers experience a temporary flow increase. Discharges usually rise through October and reach a peak in November on the Baker and upper Skagit Rivers. Winter flow peaks are typically delayed until December on the Sauk and lower Skagit Rivers, but the Cascade normally has its greatest flow in October. From their winter peaks, the rivers drop to intermediate lows in February or March when temperatures are normally low. During these months, heavy precipitation normally replenishes the snowpack at high elevations from late fall through March. Although annual peak discharge is usually the result of winter rains, in some years the peak occurs during the spring snowmelt.

The Skagit River valley has had a history of flooding dating back before 1900. Floodflows have been recorded intermittently since October 1908. Zero damage flow is considered to be 60,000 c.f.s. at Concrete. The flood of February 1951 had a peak discharge of 139,000 c.f.s. at Concrete, 150,000 c.f.s. at Sedro Woolley, and 144,000 c.f.s. at Mount Vernon. The flood remained near its peak for 6 hours at Mount Vernon, a fact which contributed significantly to the severity of flood damages. During this flood many dikes failed, because they lacked sufficient cross-sectional dimensions to withstand saturation. Table 11 lists flows above 60,000 c.f.s. at the Concrete gage.

The principal flood problems are in the section of the Skagit flood plain west of Sedro Woolley. This section comprises 75 percent of the flood plain. The present levee system in this area varies in level of protection provided, with safe channel capacity (2-foot freeboard allowance) ranging from 84,000 to 130,000 cubic feet per second, representing 3- and 11-year average recurrence intervals, respectively. Flood stages capable of doing major damage usually occur in the fall and winter months.

TABLE 11

Date	Peak Discharge (c.f.s.)	Date	Peak Discharge (c.f.s.)
30 Nov. 1909	260,000	3 Dec. 1943	65,200
30 Dec. 1917	220,000	8 Feb. 1945	70,800
13 Dec. 1921	240,000	25 Oct. 1945	102,000
12 Dec. 1924	92,500	25 Oct. 1946	82,200
16 Oct. 1926	88,900	19 Oct. 1947	95,200
12 Jan. 1928	95,500	27-28 Nov. 1949	154,000
9 Oct. 1928	74,300	10-11 Feb. 1951	139,000
26 Jun. 1931	60,600	1 Feb. 1953	66,000
27 Feb. 1932	147,000	3-4 Nov. 1955	106,000
13 Nov. 1932	116,000	20 Oct. 1956	61,000
22 Dec. 1933	101,000	20 Apr. 1959	90,700
25 Jan. 1935	131,000	23-24 Nov. 1959	89,300
3 Jun. 1936	60,000	16 Jan. 1961	79,000
19 Jun. 1937	68,300	20 Nov. 1962	114,000
28 Oct. 1937	89,600	22 Oct. 1963	73,800
29 May 1939	79,600	21 Jun. 1966	72,300
2 Dec. 1941	76,300	28 Oct. 1967	84,200

Existing protective works on the Skagit River System are composed of levees, which prevent water from flowing over land during low stage flood flows, and bank protection which prevent bank erosion and the destruction of levees. The present levee system extends along both banks of the north and south forks from their mouths to the junction forming the Skagit River. Continuous levees extend up the main Skagit River Channel past Mount Vernon to a point just above Burlington on the right bank and about 1/2 mile above the Great Northern Railway bridge between Mount Vernon and Burlington on the left bank. A levee on the right bank (facing downstream) extends about a mile downstream from Hamilton. The entire city of Burlington relies on levees for flood protection. Conway, west Mount Vernon, the central business district of Mount Vernon, and residential areas to the south are protected by levees. In all, the levee system on the Skagit protects about 46,000 acres of valley land or less than 50 percent of the flood plain.

2.33 Flood Damages. Over the recent past, the flood damage potential has been increasing in areas upstream of Sedro Woolley as much of the river shoreline has been particularly attractive for summer home developments. Many of these developments are located on reaches where the riverbank is low, resulting in damages from bank erosion, and from overtopping of low riverbanks and low levees. The greater part of past flood damage has been to land and crops in the lower valley. Major damage results from the drowning of grasses and other plants, loss of livestock, sheet erosion caused by overflow of

unprotected ground, leaching of fertilizer, infestation by weed seed, carrying away of fences, the deposition of sand, gravel, and driftwood, temporary loss of pasture because of ground saturation and loss of land through streambank erosion. Additional damage is caused to buildings and their foundations as well as damage to the contents of commercial inventories from businesses in the flood plain. Average annual flood damages in the Skagit basin have been projected to run about $4,331,000 by 1977 under 1974 prices. Future average annual damages over the period 1977-2077 and based on 1974 dollars, without additional flood protection can be expected to increase to $4,766,000.

2.34 Sediment Transport. The Skagit River transports about 10 million tons of sediment a year, based on average streamflow. Observations carried out near Mount Vernon during 1965-1966 noted sediment concentrations of from 19 to 655 p.p.m. Based on a river discharge of 70,000 c.f.s., a daily suspended sediment load of about 640,000 tons can be expected.

Reservoirs on the Skagit system tend to reduce total sediment concentrations; much of the sediment in the Baker River, for instance, is deposited in Baker Lake and Lake Shannon. Much of the eroded sediments in the Upper Skagit Basin are trapped in Ross Lake.

The most serious sediment problems are found in the Upper Skagit basin, due to the natural glacier erosion from the vicinity of Glacier Peak.

2.35 Bank Sloughing. Landslide activity and erosion are common occurrences on slopes which are filled with extensive fine grained unconsolidated deposits. Oversteep slopes in glacial deposits frequently fail by slumping, by slump-earthflow landsliding, and by calving of steep sloped reservoir walls. These occurrences are especially common in reservoirs with large fluctuations in pool levels.

Little or no sloughing appears evident along the west side of Baker Lake, due to the relatively flat slopes in the Volcanic deposits on this side of the valley. Where glacial deposits mantle bedrock on the east side of the valley, especially where the deposits are fine grained, slough and side activity is more evident.

The U.S. Forest Service has reported conditions of considerable bank sloughing in the Anderson Creek area of Baker Lake during the past few years. In addition, minor sloughing has been reported in isolated areas between Anderson and Wilker Creeks, on the east side of Baker Lake, about 1 mile upstream of the damsite. The last major landslide activity in these areas occurred in 1969 and evidence suggests that it may have been triggered by a change in drainage patterns caused by a Forest Service road built further up the slope from the reservoir.

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2.36 Geothermal Activity. Recent steam-venting activity on Mount Baker and the formation of a small lake in Sherman Crater have resulted in renewed concerns over the possibility of avalanches or mudflows sliding down the east side of Mt. Baker into Baker Lake.

Sherman Peak, which forms part of the rim of Sherman Crater, is adjacent to Boulder Glacier which leads down to the Boulder Creek Valley. The end of the glacier is about 6 miles from Baker Lake. Speculation has recently been increasing that with the ponding of water in Sherman Crater, huge mudflows could result if the water was suddenly released by rock which has deteriorated from the effects of centuries of heat and water.

Avalanches of snow, firn, rock, and mud have been fairly common occurrences in the Sherman Peak area in past years. Frank, et al, 1/ have observed that avalanches have occured at least six times since 1958, and other research has found evidence of at least two major mudflows from Mount Baker that reached what is now Baker Lake within the past several hundred years.

In the report, past avalanche activity on Sherman Peak is attributed to three conditions: A large accumulation of snow; rock broken down hydrothermically into a slippery, clay-like material; and excessive water saturating these materials as a result of summer heat or geothermal melting. Frank states that based on past experience, a new slide can be expected every 1 to 2 years as long as Sherman Peak maintains its thermal activity. The last slide occurred in August 1973.

The report points out that none of the recent slides have extended beyond the end of Boulder Glacier, but warns that repeated avalanches could undercut Sherman Peak and eventually cause a large part of it to collapse. The resulting avalanche could be 100 times the volume of any that has happened so far and extend beyond the glacier into Boulder Creek Valley or even further, the report states.

Studies are now being undertaken by the U.S. Geological Survey and by the University of Washington to determine the magnitude of recent thermal activity and the possibility of major slides.

1/David Frank, Austin Post, Jules D. Friedman, "Recurrent Geothermally Induced Debris Avalanches on Boulder Glacier, Mount Baker, Washington," Journal of Research, U.S. Geological Survey, Vol. 3, No. 1, January-February 1975, pp. 77-87.

3.0 Relationship of the Proposed Action to Land-Use Plans

3.1 Area Land-Use Plans. The proposal is consistent with the objectives of local land-use plans for Skagit County adopted in the Comprehensive Land-Use Planning Alternatives for the Skagit River Flood Plain and Related Uplands, prepared by the Skagit Regional Planning Council, April 1973.

In the above Comprehensive Plan, the regional council recommended that future development of the Skagit River flood plain be guided toward the following:

(1) Existing urban areas should be protected from 50-year frequency floods.

(2) Development of unprotected flood-plain areas should be curtailed.

(3) Existing and future agricultural use of the flood plain should be provided with at least 20-year flood frequency protection.

(4) New developments should be directed to the floodsafe and upland areas of the Skagit Region.

(5) The rural lifestyle of the area and its attendant recreational opportunities should be preserved.

To implement these recommendations, the regional council has suggested that flood-plain areas upstream of the town of Lyman be devoted to agriculture, open space and forest uses. Residential and commercial developments outside of existing urban areas would be limited. Downstream of Lyman, the flood plain would be devoted to agriculture, but mixed with forest uses in areas not suitable for development. Urban uses would be confined to existing towns with some fringe lands reserved for future development as population levels increase.

The proposed action of alternative 3, shown on page 49 of this document, is in general agreement with the regional council's recommendations and land-use plans. As the flood protection provided by this alternative is not sufficient to allow relaxation of flood-related land-use controls, development in flood hazard areas as a result of the additional flood protection are expected to be minimal. However, some development pressure may occur on specific sites within the flood plain, particularly on those lands close to existing urban areas and protected by existing levees and dikes. In such case, it is expected that other regulatory measures available to the county would be employed to limit unwanted development. Specifically, flood-plain management techniques and flood-plain zoning measures included in alternative 3 implementation are seen as the best devices for development control.

3.2 Other Plans. In addition to the plan mentioned above, there are several other county-, state-, and Federally-sponsored studies underway to determine the future potential of lands along the Skagit River System. Two of the more important efforts are studies by Skagit County under the Washington State Shoreline Management Act of 1971, and recently completed studies by the U.S. Forest Service classifying portions of the Skagit River and selected tributaries under the Wild and Scenic Rivers Act (Public Law 90-542).

3.2.1 Skagit County Shoreline Master Plan. Skagit County is in the process of developing a master plan for land use for county shoreline areas of statewide significance. When completed, this plan will classify and regulate land use within 200 feet of the Skagit River and its tributaries. The county has enacted an interim zoning ordinance until completion of their studies which enforces a 25-foot setback for construction along the Skagit River and its tributaries, and prohibits construction within the 15 year flood plain in the Skagit Basin.

The additional flood protection offered by the Baker Project proposal is entirely consistent with the intent of the Shoreline Management Act and is compatible with present zoning and building regulations.

3.2.2 Wild and Scenic Rivers Study. The U.S. Forest Service has proposed that portions of the Skagit River and selected tributaries be classified under the Wild and Scenic Rivers Act (Public Law 90-542). The Forest Service proposal recommends that the mainstream Skagit River be classified as a "Recreation" river starting from the upstream side of the pipeline crossing at Sedro Woolley upstream to Bacon Creek (about 25 miles upstream of Concrete for a total of 58.5 miles); and that the Cascade River (20.8 miles), Sauk River (50.8 miles); and Suiattle River (27.4 miles) for their entire length, be included as "Scenic" river components. Rivers recommended for inclusion into the Wild and Scenic Rivers Act total 157.5 miles in length.

The Wild and Scenic Rivers Act defines the classification of Recreation River and Scenic River as follows:

Recreation - Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Scenic - Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Along classified rivers the construction of dams, levees, and other water resource projects which would adversely affect the free-flowing character of the rivers, esthetics, water quality and other similar considerations would be prohibited. Road and utility crossings would generally be restricted to existing corridors.

The Forest Service deleted from its proposal nearly 9 miles of river below Sedro Woolley which would qualify for inclusion in the act. This was done to accommodate the development of future flood control structures, specifically a 60,000 c.f.s. emergency floodwater bypass from the Skagit River into Padilla Bay (The Avon Bypass Project). This project is now under study by the Corps of Engineers at the request of Congress but has not been authorized. (Further discussion of this project is found in sections 4 and 6 of this EIS.)

The proposed action of additional flood control storage at Baker project is compatible with the Wild and Scenic Rivers proposal of the Forest Service. The Baker project was specifically developed to accommodate Wild and Scenic Rivers status for the Skagit and its tributaries, while still achieving an acceptable level of flood damage reduction in the Skagit Valley. The Baker project would not pose any serious adverse effects to existing recreational, fish and wildlife, or environmental values inherent in the classification of the Skagit River to Wild and Scenic River status.

Beneficial impacts of the Baker project in conjunction with Wild and Scenic River classification include: Encouragement of flood-plain management techniques as called for in the proposed alternative to reduce the potential increase in monetary damage caused by floods; allows Wild and Scenic classification by providing a nonstructural alternative for increased flood protection; does not preclude the implementation of future flood control projects downstream of Sedro Woolley to increase flood protection even further.

4.0 Environmental Impact of the Proposed Action

4.1 Introduction. The proposed flood control storage project at Baker Lake will require no construction and only a change in project operation. The effects of the proposed action are anticipated to be minor in most respects. In the discussion of impacts which follow an attempt was made to isolate as many potential effects as possible, even if they seemed to have only low probabilities of occurring.

4.2 Impacts on the Human Environment

4.2.1 Population and Community Growth. The proposed action is not expected to have significant effects on population or community growth within the flood plain. New job opportunities would not be created as a direct result of the project, thereby limiting project effects on future population inmigration. The population projections presented in Section 2 should be applicable regardless of the implementation of the project.

Although increased flood control capability has the potential of creating increased development pressure on flood-plain lands, especially those close to urban areas and those now protected by dikes and levees, this pressure is expected to be minimal. To the extent that any new lands are brought into intensive development because of added flood protection, a potential for greater personal and economic losses would exist when future major floods do occur. However, the application of stringent flood-plain management techniques and flood-plain zoning by Skagit County, as called for in the recommended plan, should reduce the likelihood and severity of such losses.

4.2.2 Community Services and Facilities. The cost of flood-related community services and facilities should decrease with implementation of the proposal. A portion of local and state funds which would otherwise be appropriated for flood fighting, rescue, and repair may become available for the improvement of other community services and facilities.

4.2.3 Housing. With a decrease in the severity of flooding, homes would incur less damage, thereby allowing the homeowner to invest more in home improvements. As a result, the general quality of housing in the areas affected may increase.

4.2.4 Displaced Persons. Because the proposal would not require construction or acquisition of lands, no displacement of citizens would be required for implementation. The probability of persons being displaced by flooding will be decreased.

4.2.5 Recreation. The proposed action should have only minimal effects on recreational use of the Baker Lake area. Fishing and other recreational uses of the reservoir area such as camping and

picnicking generally conclude shortly after Labor Day of each year. As the increased drawdown will not begin until 1 November, impacts on lakeshore use for recreational purposes will be limited.

4.2.6 Health and Safety. By decreasing the severity of flooding in the lower Skagit Basin, associated public health problems should decrease. The project is aimed at minimizing the occurrence of severe floods which constitute a public health threat.

4.2.7 Employment and Income. Because the proposed action would not require construction, local employment or income levels would not be impacted to an assessable degree. Temporary disruption of employment due to flood repair will decrease slightly.

4.2.8 Property Values and Tax Revenues. The proposed action may have a slight impact on residential and agricultural property values. Permanent residences and farms damaged by past floods or structures now located in the flood plain may increase in value somewhat.

The impacts of flood protection on commercial and industrial property values are expected to be minimal. Property tax revenue may rise to the extent that assessed valuation of all affected property increases.

4.2.9 Local Government Finance. There would be no non-Federal costs associated with this proposed plan. Benefits accruing to local governments will occur as a result of decreases in damage to public facilities.

4.2.10 Business and Commercial Activity. A relatively small portion of land within the flood plain is used for industrial purposes. Because there will only be a minimal reduction in flooding frequency, industrial expansion in the flood plain as a result of the project is not expected to occur. The project would, however, provide protection to existing industry in the flood plain and thereby reduce potential future flood damages. The average annual commercial benefits over the 100-year study period as a result of the project are estimated to be about $320,000. As was the case with other economic sectors of the community, commercial development of the flood plain is not expected to increase as a result of the project.

4.2.11 Agricultural. The agricultural sector of the economy would realize economic benefits as a result of the proposed action. Average annual monetary benefits accruing to farmers over the 100-year study period are estimated at $390,000. This may induce a minor increase in agricultural development of the study area as lands could be put to more intensive agricultural uses.

4.2.12 Intangible Effects. Intangible effects of the project include reduced probability of accidental death or injury due to flooding; increased economic security of those now living within the flood

plain; reduction in costs of providing emergency flood equipment; and increased security in planting, growing, and harvesting of agricultural commodities.

4.3 Impacts on the Natural Environment.

4.3.1 Water Quality. Water quality of the Skagit and Baker Rivers is generally regarded as excellent. The Washington State Department of Ecology has classified the Baker River as AA, extraordinary. The Skagit River is classified as A, excellent, from its mouth to river mile 17 (Mount Vernon), and AA, extraordinary, from river mile 17 to the Canadian border.

Previous investigations found that bacteriological concentrations varied over the length of the Skagit River, showing a trend of decreasing quality downstream from Marblemount. Coliform counts measured in numbers of organisms per 100 milliliters of water ranged from a low of 0 to a high of 230 at Marblemount, and from a low of 0 to a high of 24,000 at Mount Vernon. Waters with coliform concentrations of 1,000 per milliliter or greater are considered as unsafe for domestic water supply and contact recreation.

Releases from Baker Lake are expected to increase an average of about 1,900 c.f.s. over existing conditions during the period of additioal 1 drawdown between 1 and 15 November of each year. These higher flows would not change the quality of water in the Skagit system now regarded as excellent or extraordinary, and may improve the water quality of the lower reaches of the Skagit through increased flushing and by maintaining the content of dissolved oxygen in river waters.

The possibility of increased levels of nitrogen supersaturation in waters released from the Upper Baker project due to spilling at the damsite was considered with water quality data collected in 1973 for Puget Power and evaluated in light of proposed operation changes. No appreciable increase in nitrogen is expected as the drawdown would generally be accomplished by passing the estimated 1,900 c.f.s. through the powerhouse rather than over the spillway.

4.3.2 Velocities. Velocities in the Baker River and the main stem of the Skagit River would increase during the first stage drawdown period of 1 October to 15 November. The Skagit River and its tributaries usually have lowflows from August through September after the snowpack has melted and ground-water flow has been depleted. Heavy rain accompanied by warm, moist winds, commonly occurs from October through February. These conditions, although coinciding with increased drawdowns, are not expected to significantly increase total flows and velocities in the Skagit River system and do not represent dangers to existing levees, increased downstream riverbank erosion, or to existing man-made structures close to river shores. Total

flows in the Skagit at Concrete are expected to increase by about 1,900 c.f.s. due to Baker Lake drawdown, representing about a 12 percent increase over average flows during October.

4.3.3 Water Temperature. The effect of Baker Lake drawdown on water temperatures in the Skagit River at Concrete were calculated not to exceed a 3° F. increase. Temperatures in downstream reaches were not predicted. The results of these calculations are summarized below:

Temperatures of water discharged from the Upper Baker and Lower Baker Dams average about 54.5° F. during October. Water temperatures in the upper reaches of the Skagit River near Concrete average about 48.2° F. during this same period. Assuming a complete mix of water at or near the convergence of these two waterways at Concrete, the additional 1,900 c.f.s. flow from the Baker at an average temperature of 54.5° F. would not increase Skagit River temperatures beyond 51° F. This temperature is well within the recommended 60° F. maximum upper limit for salmon fishery habitat, and does not represent a significant problem in terms of water-holding capacity for oxygen or other dissolved gases. Because of the minor increase in temperature, no effects are forseen on rate of fish egg incubation.

4.3.4 Flora. Existing vegetation adjacent to the reservoir pool is not expected to be affected by drawdown operations. However, the potential for abrasion of reservoir shoreline may decrease due to the proposed drawdown, and vegetative cover in some areas may then reestablish itself.

4.3.5 Fisheries Resources. Present reservoir drawdown at the Upper Baker Dam results in some sockeye salmon redd losses at higher elevations. Because Baker Lake is nearly full during the start of the spawning season in early fall, some sockeye salmon spawn in lakeshore gravels at elevations above 700 feet and as high as 720 feet. Lakeshore spawning occurs when the artificial spawning beaches are filled to capacity, which happens about once in 2 to 4 years. When lakeshore spawning begins before drawdown, some eggs at higher elevations are left exposed and consequently die. By drafting Baker Lake from elevation 720.6 to elevation 707.8, a rate of about 0.8 feet per day during 1 to 15 November, fish that otherwise might have spawned at the higher elevations would be discouraged from doing so. Because the proposed plan would also result in earlier drawdowns than has been the case in the past, there exists the potential for further reduction in redd losses now experienced during sockeye salmon spawning season. Follow up studies will be made to verify this. As lake elevations dropped, fish would seek out and spawn in other lake areas and natural spawning streams.

The U.S. Fish and Wildlife Service, with concurrences from the Washington Department of Fisheries, the Washington Department of

Game and the National Marine Fisheries Service, has recommended that the proposed plan include within it an alternative drawdown plan to be implemented in years of heavy fish returns to Baker Lake. During years when the volume of sockeye salmon returning to spawn exceeds the capacity of the artificial spawning beaches and must be released to spawn in natural lakeshore areas, it was recommended that drawdown begin immediately after Labor Day and be completed by October 1. This modification would insure that low water levels are reached before the majority of beach spawning has taken place, thereby eliminating losses of sockeye redds which now occur periodically with existing drawdown schedules.

While the proposed plan would not meet fisheries agencies' desires in years of heavy fish returns, it should result in improvements over existing conditions. Although there would be some spawning losses regardless of drawdown schedule, the proposed plan is not expected to result in greater losses, and may reduce the amount of redd losses now experienced. Future studies would be conducted to determine the extent of impacts to Baker Lake spawners if the proposed plan is authorized. These studies would be partially funded by the Corps of Engineers in conjunction with the Washington Department of Fisheries, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service.

Keeping Baker Lake below 707.8 feet through the spawning season, except during actual flood control operation, would not inhibit fish access to major spawning streams. Past observations have shown that stream access is not a serious problem until the pool reaches elevation 688 feet.

4.3.6 Fauna. As reservoir levels would not be increased beyond those currently in use, and since no further construction will be needed to implement the proposed drawdown, impacts to wildlife resources are expected to be negligible.

4.3.7 Erosion. Baker Lake will be subject to slightly increased levels of shore erosion due to the exposure of additional land area during the reservoir drawdown period of 1 October to 1 March of each year. The drawdown schedule coincides with the wet season beginning in October and November and lasting from 6 to 7 months. Typically, about 80 percent of the yearly total precipitation falls during this period with November, December, and January the months of greatest precipitation. The soil formations adjacent to Baker Lake are classified as sandy and gravelly loams with parent material consisting of gravelly, stony, and sandy loams on bedrock or glacial ablation or basil till. Soil ph is slightly acidic and soil resistance to erosion is classified as low to moderate. While the climatic and geologic conditions of the area will contribute to additional deposition of silt and debris downstream, and produce a measure of additional scouring of the exposed lakeshore the overall impacts of these changes in relation to water quality, fish habitat, and marine vegetation is expected to be minimal.

4.3.8 Visual Landscape. Earlier reservoir drafting would expose about 13 additional feet of lake bottom consisting of rotting tree stumps, rock outcroppings, and mud flats. The recreational experience of those using the reservoir at these times would be diminished. However, this impact is expected to be minor due to the normally low recreational use of the area during months when reservoir drafting is scheduled to occur.

4.3.9 Mt. Baker Volcanics. Although the possibilities are very remote, recent steam venting on Sherman Peak could spark a mud-flow down Boulder Glacier to the east and into Baker Lake. There is evidence that at least two and possibly more slides similar to this have occurred in the past few hundred years. Depending upon the size and extent of such an occurrance, the proposed action could result in a benefit. By holding the reservoir at lower levels for a longer period of time, a measure of mitigation would be provided. However, if such a slide were extensive enough, it could cause a wave to overtop the dam at any pool level and cause downstream damage.

4.4 Impacts Resulting from Project Operation.

4.4.1 Flow Regimen. The proposed plan would change the flow regimen of the Skagit River below Concrete when the Baker Lake water level is drafted an additional 12.8 feet between 1 to 15 November. At present, Baker Lake is drawn from elevation 724 feet to elevation 720.6 feet during October. However, the lake has been lowered to below elevation 700 feet in most years to satisfy power requirements. The proposed action would require storage evacuation to a maximum of 707.8 feet for flood control during the first part of November to provide 58,000 acre-feet of additional storage for a total of 74,000 acre-feet. The storage space would be used when the unregulated discharge of the Skagit River near Concrete is forecast to exceed 90,000 c.f.s. At that time, discharge from Upper Baker Project would be reduced to minimum required for power generation, 5,000 c.f.s. When the Skagit River reaches its maximum discharge near Concrete and begins receding, storage at Upper Baker Project would cease and Baker Lake would be drafted to elevation 707.8 feet at a rate which would not reverse the Skagit River recession.

4.4.2 Power Losses. The power-generating capacity of the Upper Baker Dam would be reduced by changes in operation necessary to provide increased flood control. Power losses would consist of energy losses and capacity losses. Energy loss would result when water which ordinarily would be passed through the power units is routed over the spillway to make storage space available for flood control. Capacity loss would be realized because flood regulation would require reservoir drawdown which reduces hydraulic head available for power generation.

Average energy loss as a result of provision of additional flood control storage over the 5 month period has been estimated to be 2.681 megawatts or 1.117 megawatts annually. Typically, 400 to 500 all electric homes could be serviced by this amount of power if it were available in the future.

Capacity power loss during the period of required drawdown has been estimated to range between 6.3 and 0.2 megawatts depending upon whether or not the project is dedicated to supplying maximum power during periods of peak demand. The loss of 6.3 megawatts would represent a reduction of about 0.8 percent of the total peaking capacity of existing Skagit River hydropower plant or about a 0.5 percent reduction in required peak for a city about the size of Seattle. Puget Power has indicated that in absence of the proposed plan Upper Baker project would in the future be operated more as a peaking plant. During the normal flood control period under existing conditions, the pool would be kept as near elevation 720.6 as possible during the flood season in order to maximize peaking capability.

Puget Power would be reimbursed for power losses resulting from the provision of additional flood control storage space through replacement power in kind from the Bonneville Power Administration (BPA). Net power losses in terms of revenue foregone by the Federal Government in providing replacement power would be approximately $56,000 annually, based on rate schedules in effect in May 1975. However, BPA itself would be fully compensated in that annual revenues foregone would be considered a nonreimbursable Federal flood control cost, to be deducted each year from the reimbursable power operation and maintenance account of the Chief Joseph Dam, Washington, project.

The methodology used by Puget Sound Power and Light Company in determining power loss is cited as follows: 1/

"Studies performed to determine the power and energy losses of the Baker Project were made with a computer code entitled, "Baker River Hydro-Reg."

This computer program is a mathematical model of the Upper and Lower Baker Plants. The model consists of power generation module and a reservoir module for each plant. The power generation module develops power from the routed natural flow and any storage is dictated by the rule curves for each day. The generation module computes the hydraulic head from the reservoir elevation and the tailwater characteristics. The capacity and energy are selected from (P-Q-H) tables that correspond with the hydraulic head and plant discharge. Daily reservoir elevations are determined by proportion draft to meet specific rule curve elevation.

1/The methodology was provided in a letter from the P.S.P.L. dated May 3, 1974. The full text of the letter and supporting figures can be found in appendix 2 of the draft authorization report, Baker Project.

The parameter which defines the study conditions are the historical natural flows, the design of the reservoir rule curve and the physical characteristics of the plants.

The output is printed on magnetic tape and hard copy. The hard copy shows all physical characteristics for each plant for each day. This includes:

1. Month
2. Day
3. Year
4. Natural flow at site (QN)
5. Draft from upstream storage (QUS)
6. Draft from at site storage (QS)
7. Total plant discharge (QD)
8. Spill (Spill)
9. Accumulated Draft (MSFM & MSFD)
10. Reservoir elevation (ELEV)
11. Conversion Factor (H/K)
12. Power from natural flow (PN)
13. Power from storage (PS)
14. Average power (PA)
15. Capability (P)
16. Plant identification (PL-ID)
17. Accumulated draft at site (SEINIT)

The hard output for a five year study is a very large volume. A computer code entitled, "Summary" has been developed to summarize the results of these studies. Monthly results on an annual basis for each study are printed in hard copy form for ease of analysis."

Although the amount of power lost is small when compared to the total production in the Bonneville system, there would still be some net loss in the Northwest system production capability. These losses would occur during the winter season when peak energy demand is at its highest. Moreover, coming at a time when future power shortages are anticipated to occur, the proposed project operation change could contribute to future shortages in the Pacific Northwest. These net losses would contribute cumulatingly to future power shortages which may justify construction of new generating facilities.

4.5 Impacts of Proposed Project in Relation to Other Anticipated Developments.

4.5.1 General. A number of Skagit River basin flood damage reduction alternatives have previously been considered during the Puget Sound and Adjacent Waters Comprehensive Study. Raising of the existing levees downstream from Burlington and improving the channel at several locations are elements of the comprehensive plan, adopted by the Pacific Northwest River Basins Commission, as well as Skagit

County's Comprehensive Flood Control Plan. A proposal to construct a bypass, termed the Avon Bypass project also is an element of these plans.

Skagit County has recently indicated they will oppose classification by Congress of the Sauk River as part of the National Wild and Scenic River system. National classification would preclude a future storage project on the river and prevent the county from exercising an option for additional flood protection. The county commissioners, reflecting the views of the basin residents, are desirous that flood control on the magnitude of 50-year protection be provided. This level of protection could only be achieved through a combination of measures, including additional storage at the Upper Baker project, and construction of the levee and channel improvement and the Avon Bypass or a dam on the Sauk River.

4.5.2 Levee and Channel Improvements. The Flood Control Act of 1966 authorized construction of a levee and channel improvement project along the Skagit River from just upstream of Mount Vernon downstream along both its north and south forks. Also authorized by the 1966 act was Federal involvement in the inclusion of recreation facilities as part of the Avon Bypass project. The levee and channel improvement project would provide a uniform minimum safe channel capacity of 120,000 c.f.s. from just upstream of Burlington downstream through the delta. This capacity would allow safe passage of floods (under existing conditions of upstream storage) having an average recurrence interval of up to 8 years. In combination with the Avon Bypass, the levee and channel improvement project would provide protection against floods having an average recurrence interval of up to 35 years. The latter project has been held up pending additional storage development or construction of the Avon Bypass.

4.5.3 Avon Bypass. No Federal flood control works have been constructed in the Skagit River basin. The Flood Control Act of 1936 authorized the Avon Bypass, a project for the partial control of floods in the lower Skagit Valley. The bypass channel, as proposed, would divert excess Skagit River flow from the main river channel near Burlington to Padilla Bay. The project has not been undertaken, as Skagit County has been unable to meet the requirements of local participation. Substantial costs would be involved in the relocation of transportation facilities and the acquisition of right-of-way. Also, the project would pass through an area used for agricultural purposes, resulting in significant disruptions. The most recent studies, conducted in 1966, indicate the Avon Bypass should have a capacity of 60,000 c.f.s., although it would be possible to construct the facility to handle largerr flows.

4.5.4 Possible Development Sequence. In 1970, Skagit County adopted a comprehensive flood control plan when they formed a countywide flood control district in accordance with the laws of the State of Washington.

The flood control district enables the county to assume the responsibility of sponsorship of various flood control improvement projects. The levee and channel improvement project authorized by the Flood Control Act of 1966 is viewed as phase one of the county's comprehensive flood control plan. Phase two of the plan provides for obtaining flood control storage from the existing Upper Baker River project. Phase three would be additional flood control storage on the Sauk River and/or construction of the Avon Bypass. The county has consistently, at public meetings and in correspondence to Senator Warren G. Magnuson in June 1974, reaffirmed its desire for flood control improvements, particularly additional storage at the Upper Baker Project. Skagit County has asked that the previously authorized Skagit River levee and channel improvement project be undertaken as soon as possible. The provision of additional flood control storage at Baker Lake is expected to allow this project to proceed.

5.0 Unavoidable Adverse Environmental Impacts.

5.1 Earlier reservoir drafting of about 12.8 feet would further expose the shoreline during November. However, as Baker Lake is normally drafted for hydroelectric generation below elevation 707.8 by early January, the net change in shoreline exposure would not be significant, although the increased length of time shoreline areas are exposed to the erosive forces of wind and weather could result in additional lake siltation and turbidity.

5.2 The additional flood control storage may create a false sense of security among those now living within the flood plain. To the extent that this additional security results in increased activity in flood plain development, greater potential would exist for personal and economic losses associated with future floods.

5.3 Needed hydroelectric power would be lost due to the reduced hydraulic head between lake elevations of 720.6 feet and 707.8 feet. These losses would occur during the winter season when peak energy demand is at its highest. The proposed project would cumulative add to future potential energy shortages in the Pacific Northwest, although not greatly, but may have to be made up through other means such as construction of new generating facilities.

6.0 Alternatives to the Proposed Action.

6.1 Introduction. This section presents the alternatives that were considered during the planning process, as well as variations of the plan finally recommended. The alternative selected for action is number 3, found on page 49. The format used here to present the major alternatives considered is the same as was used in the public brochures distributed during the study for public comment. In addition, the rationale used for rejection of alternatives is included.

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6.1.1 ALTERNATIVE 1

DO NOTHING

DESCRIPTION: No additional structural measures would be constructed to reduce flood damages. Existing levees would be maintained and Ross and Upper Baker storage projects continued to be operated for flood control as they have been in the past. Flood plain management would be limited to control exercised through county and incorporated community land-use zoning.

EFFECTS:

Fish and Wildlife: Further loss of wildlife habitat expected with development of flood plain lands.

Recreation: Increased recreation homesite developments expected in flood hazard areas.

Land Use: More intensive development expected than would be the case with flood-plain regulations.

People: Present population growth trends would continue.

Flood Damage: The approximately 100,000 acres of Skagit River flood plain downstream of the mouth of Baker River, near Concrete, would continue to be subject to the current level of flood risk with future damages expected to increase over that expected with an adequate flood plain management program.

REASON ELIMINATED: This alternative would not be responsive to expressed desires of the public and Skagit County for action leading to reduction of existing flood problems. As Skagit County and State of Washington are moving forward with strengthed flood plain management programs implementation of this alternative would be a step backward from pursuing Federal and state goals and policies which call for reduction of flood damages and flood risk. The majority or agencies, groups, and individuals responding to this alternative indicated their opposition to it.

6.1.2 ALTERNATIVE 2

FLOOD PLAIN MANAGEMENT ALONE

DESCRIPTION: No additional flood control structures would be constructed. Existing levees would be maintained and Ross and Upper Baker storage projects continued to be operated as they have in the past. In addition, the following specific nonstructural measures would be relied upon to lessen the growth in flood damage potential:

a. The existing warning system would continue to provide residents of the Skagit basin advance notice of impending floods in sufficient time to permit them to evacuate some personal property. Flood forecasts are issued by the U.S. Weather Bureau and broadcast by radio and television stations with Skagit County Civil Defense Office responsible for alerting people to the danger of impending floods.

b. Flood proofing would be applied to all future development in the flood plain. In most cases, this would involve placement of fill and constructing the ground floor of structures above the 100-year flood level. The majority of existing developments in flood hazard areas are not expected to be flood proofed due to the expense involved and the availability of relatively inexpensive subsidized flood insurance.

c. New construction would be severely restricted if not precluded in designated floodway areas.

d. The flood insurance program, established under the Housing and Urban Development Act of 1968, as amended in 1973, would be used to make available Federally subsidized flood insurance. Skagit County is presently qualified for this insurance, which applies to one-to-four family dwellings, properties occupied principally by small business, and to the contents of properties of these types. Cropland, industry, and large businesses are not eligible for flood insurance. Other losses, such as interruptions to transportation, also are not covered.

ANNUAL COSTS:

Federal - USCE and HUD	$248,000	(flood information & insurance)
State of Washington	8,000	(flood plain zoning & permits)
Skagit County	20,000	(flood plain zoning & permits)
Individuals	65,000	(flood proofing & insurance)
Total	$341,000	

EFFECTS:

Fish and Wildlife: Existing trends would continue.

Water Quality: Existing trends would continue.

Recreation: Existing trends would continue.

Land Use: Conversion of agricultural and open space lands to intensive uses would be less than under alternative 1.

Flood Damage Prevention: Flooding would continue; however, damages to future developments in flood prone areas would be lessened due to flood proofing, advanced flood warning, and restrictions designed to keep development out of extreme flood hazard areas.

Transportation: Road, highway and rail traffic would still be subject to disruption during floods.

ECONOMIC ANALYSIS:

Average annual benefits	$1,058,000	(flood damage reduction & flood insurance pay-outs)
Average annual costs	341,000	
Benefit-cost ratio	3.1	

REASON ELIMINATED: Would not be responsive by itself to expressed desires of Skagit County for measures which would reduce the current flood threat. Structural solutions are required in order to increase flood protection for existing developments. Alternative 2's main effectiveness would be in controlling future developments. Through public brochure drafts and at a meeting held in Burlington in April 1973, public appeared to favor combining this alternative with additional flood control storage at the Upper Baker project (alternative 3).

6.1.3 ALTERNATIVE 3

FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT THE UPPER BAKER PROJECT

DESCRIPTION: Flood plain management measures defined under alternative 2 are included in this proposal, which calls for a change in operation of the existing Upper Baker hydroelectric project, owned and operated by Puget Sound Power and Light Company. The Upper Baker project currently provides 16,000 acre-feet of flood control storage, as compensation for natural valley storage lost due to construction of the project. The Federal Power Commission project license allows up to an additional 84,000 acre-feet of flood control storage to be utilized at the project, provided that Puget Power is satisfactorily compensated for the attendant reduction in power production capability. The following alternative volumes of increased storage were examined:

Storage Space (acre-feet)		Minimum Flood Control Pool Elevation
Additional	Total	
84,000	100,000	701.4
58,000	74,000	707.8
50,000	66,000	709.8
40,000	56,000	712.1

The recommended plan calls for an additional 58,000 acre-feet of storage space to be provided by 15 November. The pool would be kept below elevation 707.8 from 15 November, except during an actual flood event, until 1 March. Full use could be made of the reservoir's capacity for hydroelectric power generation by 1 April.

IMPLEMENTATION COSTS:

Federal - $21,000 - Preparation of reservoir regulation manual and negotiation of power loss evaluation agreement.

AVERAGE ANNUAL COSTS:

Actual

Federal - $68,000 - Federal power revenues foregone in providing replacement power from the Federal system to Puget Power and allowance for administrative costs associated with Upper Baker project flood control operation, including follow-up monitoring of enviromental impacts during first 5 years of changed operation.

Economic

Federal - $434,000 - Alternative cost of replacement power and average annual administrative costs associated with additional flood control at Upper Baker project.

AVERAGE ANNUAL BENEFITS:

Flood damage reduction - $1,127,000

BENEFIT-COST RATIO: 2.6 (economic)

UPPER BAKER FLOOD CONTROL WITH
FLOOD PLAIN MANAGEMENT

AVERAGE ANNUAL COSTS: $775,000

AVERAGE ANNUAL BENEFITS: $2,185,000

BENEFIT-COST RATIO: 2.8 (economic)

EFFECTS:

Fish and Wildlife: Reservoir fishery would not be adversely affected. Additional water, released from the Upper Baker project, during flood control drawdown, would augment Skagit River flows during salmon spawning.

Water Quality: Lower reservoir levels during the period of heavy winter rains could increase siltation in Baker Lake and result in higher turbidity downstream.

Recreation: Downstream Skagit River sport fishery could be improved by low-flow augmentation.

Land Use: The increased flood protection provided by this alternative would not be sufficient to allow relaxation of current restrictions on intensive developments in flood hazard areas. Therefore no effect on land use is expected.

Flood Damage Prevention: Additional flood protection would be provided for nearly 100,000 acres of Skagit River flood plain located below the mouth of Baker River, near Concrete.

Power Lost: Hydroelectric power generation capability at the Upper Baker project would be reduced due to the requirement for

a lower pool during the winter flood season. This could contribute to power shortages in the Pacific Northwest. However, the relatively small amount of power involved is not expected to significantly impact the overall system. Puget Power would receive replacement power in kind from the Bonneville Power Administration (BPA). Net power losses, in terms of revenue foregone by the Federal Government, in providing replacement power would be approximately $56,000 annually, based on rate schedules in effect in May 1975. However, BPA would be fully compensated in that annual revenues foregone would be considered a nonreimbursable Federal flood control cost, to be deducted each year from the reimbursable power operation and maintenance account of the Chief Joseph Dam, Rufus Woods Lake, Washington, project.

OTHER EFFECTS: Other impacts on authorized Corps of Engineers flood control projects are as follows:

a. Levee and Channel Improvements: The project authorized by the 1966 Flood Control Act for improving the Skagit River channel and raising and strengthening about 34 miles of levees downstream of Burlington would be augmented by this alternative. Although now in a deferred status, if the levee and channel improvements are constructed in the future, the combination would increase the minimum level of protection from 3 years to an average recurrence interval of 11 years. However, if implemented, flood protection would increase in the area from Burlington downstream.

b. Avon Bypass: This project was authorized by the Flood Control Act of 1936 and modified in 1966. It consists of a diversion channel 8 miles long from near Burlington to Padilla Bay; a 4-mile levee; drainage structures; and widening of the Skagit River channel for 2 miles. The project is currently in a deferred status, but if constructed in the future, subsequent to Alternative 3 and the levee project, would increase minimum flood protection from 11 to 59 years, for the area from Burlington downstream.

6.2 Other Proposals Considered.

6.2.1 Reservoir drawdown to provide 58,000 acre-feet additional flood control storage (Alternative 3), but with drawdown to start directly after Labor Day of each year. The direct benefits of this proposal would accrue to anadromous fish which spawn in Baker Lake.

Reservoir drawdown under this proposal would begin 1 day after Labor Day of each year, and would be completed no later than 1 October. This action would provide fisheries benefits by decreasing the magnitude of sockeye salmon egg losses now experienced under present Upper Baker Dam operating schedules because of redd dewatering. Flood control benefits would remain the same as in Alternative 3.

This proposal is not presently being considered due to the constraints placed on the scope of possible alternatives by the Federal Power Commission license authorizing the Upper Baker project. As this license limits reservoir drafting modifications to flood control only, reservoir regulation in the interest of possible fisheries enhancement benefits would require a change in the terms and conditions of the license. A request for such change is outside the scope of the present study. Also, early drawdowns may be detrimental to resident sport fishery and recreation use of the reservoir. This alternative would necessitate drawdowns during the late summer recreation season when the area is still in moderate use by the public. Additionally, the fishery enhancement benefits that might be derived from earlier drawdowns would have to exceed the economic value of greater power losses resulting from earlier drawdown in order to be justified.

7.0 The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

7.1 The proposed plan for Upper Baker flood control would increase protection of existing developments if the Skagit River floods but is not expected to have generally unfavorable short-term environmental impacts. The existing values of the area (recreation, wildlife, agriculture, urban life) would not be compromised with implementation of the project. Although there is a possibility that pressure for unwanted development of protected flood-plain lands would occur, it is likely that these pressures would be minimal because of the limited protection afforded by the project. Beyond this, any additional development pressures can be controlled through adequate planning of flood-plain lands and the institution of flood-plain zoning techniques.

7.2 The effects of the project on long-term productivity and maintenance of the environment are similarly judged to be beneficial. The project would continue to assist in maintaining the present level of economic and agricultural development of the region. Important other uses (fishery resources, for instance) of the area would not be irretrievably or irreversibly damaged over the long term.

8.0 Irreversible and Irretrievable Commitments of Resources Which Would Be Involved Should the Proposed Action Be Implemented.

8.1 Until such time as the public interest demands otherwise, the operation of Upper Baker Project would be irreversibly committed to the provision of storage space for flood control purposes during winter months. This use would constrain use of the entire range of the reservoir during the winter months, thus restricting power generation operations.

8.2 Future commitments of resources for alternate means of power generation such as coal, gas, oil, or nuclear materials may be needed to make up for the net power lost due to this project.

8.3 Annual Federal power revenues in the amount of $56,000 would be foregone with an irretrievable commitment to provide replacement power from the Federal system. As a consequence, opportunities could be foregone for other areas of public investment unrelated to flood control which might prove to have greater benefits to the quality of life.

9.0 Coordination With Others.

9.1 Public Workshops. A public workshop was held on 25 April 1973 in Burlington, Washington to determine the desires of interested citizens and a public meeting was held on 8 April 1975 in Mt. Vernon to present findings of the study. Forty-three persons attended the workshop, 17 gave testimony, and 3 letters were submitted, 2 before the meeting and 1 directly afterwards. There was general agreement among the participants on the need for flood control, however, there was disagreement on the means by which flood control could be attained. The 8 April 1975 meeting was attended by 45 persons.

9.2 Public Brochures. The Baker Lake flood control study got underway early in 1972, with a first draft public brochure mailed to interested parties in October 1972. This first brochure contained the original alternatives developed by Corps of Engineers and local interests. From November 1972 to February 1973, the public comments received on the alternatives were evaluated. At that time a tentative selection was made of the best alternative.

Draft #2 of the public brochure was prepared during March and April of 1973 listing all Pro and Con comments received from the public via the initial draft. This second draft brochure was then mailed to interested parties and the 25 April 1973 public workshop was announced.

A third draft brochure was prepared during May and distributed in June of 1973, again listing all Pro and Con statements received via draft brochure #2. This brochure draft was distribute to the public requesting additional views and comments. Fifty-two local, state, and Federal agencies, associations, and organizations participated in preparing the brochure through their responses. In addition, 17 unaffiliated persons participated. Prior to the 8 April 1975 public meeting, draft brochure #4 was prepared outlining the tentative recommendation for flood control and explaining the course of the study up to that time. (Please see appendix.)

9.3 Public Brochure Participants. The following is a list of those organizations and individuals who participated directly in the preparation of draft brochure's No. 2, 3, and 4.

ORGANIZATION

LOCAL

Skagit County
- Engineer
- Planning Department
- Flood Control Council
- Soil and Water Conservation District
- Farm Bureau
- PUD
- Commissioners

LOCAL (Con.)

City of Burlington
  Planning Commission
  Public Works Director
City of Sedro Woolley
City of Mount Vernon
City of Lyman Planning Commission
Puget Sound Power and Light Company
Whatcom County
Town of Hamilton

STATE

Dept. of Ecology
Land Planning Commission
Dept. of Fish
Dept. of Game
Dept. of Natural Resources
Planning and Community Affairs
Commerce and Economic Development
NW Air Pollution Authority
State Ecological Commission

FEDERAL

Soil Conservation Service
Mount Baker National Forest
Baker River Ranger Station
Bureau Sport Fisheries and Wildlife
Bureau Reclamation
Bonneville Power Administration
National Marine Fisheries Service
National Weather Service
Federal Power Commission
Environmental Protection Adm.

MISCELLANEOUS ORGANIZATIONS

Drainage Districts
  District No. 21, Mount Vernon
  District No. 14
  District No. 13
Diking Districts
  District No. 12, Sedro Woolley
  District No. 12, Mount Vernon
  District No. 21
  District No. 2, Mount Vernon

MISCELLANEOUS ORGANIZATIONS (Con.)

Diking Districts (Con.)
District No. 17
District No. 15
District No. 20
Granges
Skagit Valley Grange #620,
Mount Vernon
Sierra Club
Wash. Environmental Council
Audubon Society
League of Women Voters
Pacific NW Water Assn.

INDIVIDUALS CONTRIBUTING TO BROCHURE

Robert K. Hammond	Margaret Yeoman	Bob Lundvall
Joe E. Kalt	Norman Hesseldahl	Stephen C. Mengler
Lou St. John	Paul Wilcox	

9.4 Comments from Public on Draft Environmental Statement. Comments on the draft EIS are found below. The full text of letters received commenting on the draft environmental statement are found starting on page 79. Comments on the revised draft EIS are found in section 9.6, and copies of the original letters are found starting on page 120.

1. United States Department of The Interior, Bureau of Land Management.

Comment: There are numerous unsurveyed islands in the Skagit River below its confluence with the Baker River and several others in Skagit Bay at the river mouth which are under BLM administration. We do not believe, though, that the proposed project will have any adverse impacts on BLM programs or plans for these Natural Resource Lands.

Response: Comment acknowledged.

Comment: The Skagit River upstream from the town of Mt. Vernon has been declared by the Congress as a study river for possible inclusion in the National Wild and Scenic Rivers System (PL 90-542 of 10-2-1968).

Since the proposed project will withhold water from or release water to the Skagit River, depending on the flood control cycle, the effect of the project on the possible addition to the National Wild and Scenic Rivers System should be discussed. The statement should show positive evidence of correlating this project with the scenic rivers study being conducted by the Forest Service, the lead agency for the study.

Response: We have coordinated with the Forest Service throughout our respective planning periods. The Forest Service has just recently released their draft EIS concerning inclusion of the Skagit River system into the Wild and Scenic Rivers classification. The environmental effects of the Baker Lake Project on the Forest Service proposal is treated in Section 3 of this final EIS.

2. Advisory Council on Historic Preservation.

Comment: This is in response to your request of February 28, 1975 for comments on the draft environmental statement for the proposed Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that your draft environmental statement appears adequate regarding our area of expertise and we have no further comment to make at this time.

Response: Comment acknowledged.

3. United States Department of the Interior, Bureau of Mines.

Comment: The proposed modification in the operation of Upper Baker Dam and Reservoir for flood control purposes would not adversely affect mineral development in the Skagit River basin. Both documents adequately discuss the basin's mineral resources commensurate with the proposed action.

Response: Comment acknowledged.

Comment: The environmental statement should include any adverse or beneficial impacts as they relate to the proposed Skagit River Wild and Scenic River. The Forest Service provided information for the study (Authorization Report, page A-3), but a direct reference could not be found in the statement.

Response: The final EIS has been expanded to include the Forest Service proposal for inclusion of the Skagit River System into the Wild and Scenic Rivers classification. Documentation of the proposal and the effects of the Baker Lake Project on these plans are found in Section 3.

Comment: The statement does not mention the proposed Skagit Nuclear Power Project located just north of the river between Sedro Woolley and Lyman. Will the project have any adverse or beneficial effects upon the proposed power project?

Response: The Skagit Nuclear Power project is unrelated to the Baker project. Outside of both being located in the same general region and being power projects, there are no other similarities in the two projects.

Comment: Increased steam venting has occurred recently from Mt. Baker. Should this increase in venting activity continue or foreshadow a general increase in volcanic activity, the results could have a great impact upon the downstream Baker River system. Such impacts as avalanches and sudden release of waters from debris dams should be discussed in this environmental statement. One of the latest references to the increase in geothermal activity is "Recurrent Geothermally Induced Debris Avalanches on Boulder Glacier, Mt. Baker, Washington" by David Frank, Austin Post, and Jules D. F. Friedman, Journal of Research, U.S. Geological Survey, January-February 1975, Volume 3, No. 1, pp. 77-87. Further references are listed in this paper.

Response: Volcanic mud flows and debris flows down valley tributaries to the west bank of the present Baker Lake have occurred during the past several hundred years. We believe that holding the reservoir at lower levels for a longer period of time will provide a measure of mitigation should such an event occur while the reservoir is down, unless the debris flow is extremely large or close to the dam. We do not dismiss the possibility that a large debris flow could cause a wave to overtop the dam at any of the pool levels under consideration and cause downstream damage. Please see section 4.3.9.

4. United States Department of the Interior, Fish and Wildlife Service.

Comment: Page 8, Section 2.10, Fisheries and Wildlife Resources (draft statement). Steelhead fishing is mentioned as outstanding in Skagit River. Other important fish and wildlife values, including waterfowling on Skagit Flats, and saltwater salmon fishing should be included. Economic values for fish and wildlife resources should also be stated as those for agriculture.

Response: The final EIS has been revised under section 2.10 to more comprehensively cover the fish and wildlife values found in the study area. Tables 1, 2, and 3 have been included to display the value of catch for sport fisheries and game in 1973.

Comment: Page 10, Section 2.13, Land Use (draft statement). Land use with associated water requirements in Skagit County should include fish and wildlife.

Response: Fish and wildlife are documented under section 2.10. The land use discussion found in section 2.1.3 is intended only to give the reader a generalized picture of existing land use patterns in the Skagit River flood plain and related uplands.

5. Washington State Department of Game.

Comment: Consideration of timing of reservoir filling and how this will be affected by the proposed project is needed.

The report states additional flood control storage is to be available until 1 March, then filling "would begin and usually be complete by 1 April." (page ii, paragraph 1). Later the statement says filling "can" begin after March with "target date of 1 April" (page 2, paragraph 1). It goes on to say filling in "some" years "might" be later due to hydrologic conditions. This is very vague; clarification is needed in the final report.

Response: The above referenced statements have been revised as follows: "Storage capacity of 74,000 acre-feet would be reserved for flood control until the first of March, except when regulating for flood control. Puget Power could still draw the reservoir below 707.8 during this period for power production purposes. The required flood control storage capacity would be gradually reduced during March to permit Puget Power to refill to full pool, elevation 724, by 1 April." When a large snowpack exists, the reservoir may be held below full pool later than 1 April in order to capture the excess runoff for power generation.

Comment: (Reservoir) Filling too early (i.e., before emergence of Dolly Varden and kokanee fry) could adversely affect spawning success by slack-water inundation of spawning areas. If the reservoir is drawn down further than is the current practice, this could result in adverse impact on kokanee or Dolly Varden, depending on where they spawn.

Response: Conditions with the proposed operation change at Upper Baker Project during the refill period are not expected to differ appreciably from existing conditions. Therefore, the proposal should not adversely affect fisheries resources.

Comment: Late lake filling could adversely affect rainbow and cutthroat by encouraging spawning in stream areas that are later inundated. Since only small numbers of cutthroat and rainbow "natives" apparently exist in Baker Lake, this may be happening now. But data on spawning time and locations is needed to make a conclusive statement on this one way or the other. In summary, late lake filling could be advantageous for fall spawners (Dolly Varden and kokanee) but could be detrimental to spring spawners (rainbow and cutthroat trout).

Response: See previous comment.

Comment: Consideration of the relationship between project proposal and maximum drawdown for power generation is also needed. You stated, in part, "Alternative 3 proposes...holding the reservoir below elevation 707.8 feet...additional storage would be available...from

15 November to 1 March..." (page 2, paragraph 1). How far below elevation 707.8 feet would the reservoir be drafted as opposed to present conditions? We expect that drawdowns more severe or lengthy than presently experienced will adversely affect carrying capacity and productivity of the lake.

Response: Drafting of Baker Lake to elevations below our proposed 707.8 feet would be dependent upon the power generation requirements of Puget Power and on climatological conditions. The operation of the dam should not in the near future, however, result in any ssignificant departures from past years as shown in figure 1 of this final EIS. In the long term Puget Power has indicated that they expect the drawdown to be less pronounced as the project will be operated more as a peaking project. As is mentioned on page 1, in normal years, Baker Lake is lowered to 700 feet elevation by mid-January for power generation purposes.

Comment: You may wish to mention the following information on Baker Lake's resident fishery in the Fisheries and Wildlife Resources section (pages 8-10). Kokanee, Dolly Varden, rainbow and cutthroat trout are all present in Baker Lake as self-sustaining populations (legal rainbows are reared and released for a put-and-take fishery, as you have stated). Kokanee are the most important species present; they sustain the largest naturally-produced harvest by far. Dolly Varden are harvested in smaller numbers but achieve "trophy size" and are specifially sought after by some anglers. Self-sustaining rainbow and cutthroat populations are small and contribute little to overall harvest.

The 1971 Baker Lake Creel Census (James Cummins, WDG, Dec. 1971) reported an estimated catch of 9,826 rainbow trout from a plant of 55,000 catchable size fish, 10,658 kokanee and 1,524 miscellaneous species - a total of 21,998 fish for the census period (1 July through 6 September, 1971). The survey showed the average angler fished 2.94 hours and caught 2.73 fish per trip (1.21 rainbow and 1.40 kokanee; average catch per trip). This yielded a total projected time of 25,538 man hours of fishing during the census period.

Many of the types of wildlife which may use Baker Lake and surrounding region are mentioned in this section. Swan should be added. You may also wish to mention that ospery nesting is reported on the east shore of Baker Lake. Baker Lake vicinity probably supports a fair number of ruffed grouse and a good population of racoon (Brown, Judith, Fish and Wildlife Resources of Mount Baker National Forest, Applied Research Bul. No. 2., Mar. 1974, WDG, pages 41, 42, 48).

Response: Section 2.10 has been expanded to include the above information relating to fishery and wildlife resources, while section 2.12 has been expanded to include the results of the Baker Lake Creel Census.

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Comment: In addition to information on impacts on Baker Lake's resident fishery requested above, we suggest the final impact statement also include a discussion of project effect on turbidity conditions in Lower Baker and Skagit Rivers.

Response: As the draft EIS pointed out in Section 4.3.7, because of earlier drawdown during the "wet season" and because of the soil properties adjacent to Baker Lake, we expect additional scouring of the lakeshore and additional deposition of silt in Baker Lake. However, owing to the relatively minor increase in water outflow from Baker Lake during the drawdown period of 1-15 November, turbidity conditions in the Lower Baker Project (Lake Shannon) and Skagit Rivers are not expected to increase significantly.

Comment: Future studies to determine extent of impacts on Baker Lake spawners, if the proposed plan is implemented, are mentioned on page 53. We suggest the scope of the study be expanded to include resident game fish stocks which heretofore appear to have been overlooked.

Response: Future studies are intended to cover the impact of the Baker Lake proposal on Sockeye Salmon. However, if it is found that adverse impacts occur to resident fish, the nature and extent of these impacts will be studied as well.

Comment: Your assessment of effects on wildlife resources (page 53) addresses effects which may be sustained at Baker Lake. A decrease in open water space available to waterfowl will be experienced; you may wish to mention this also. Secondary impacts on wildlife should be acknowledged. The proposal seeks to provide additional flood protection to nearly 100,000 acres of floodplain and thus opens a potential (however small) for increased loss of wildlife resources existing in this floodplain area. The proposal will also help pave the way for stream and channel improvements and the Avon Bypass, projects which may result in adverse impacts on fish and wildlife.

Response: No net decrease in Baker Lake water surface area will result from the project. Any additional flood control project will have to be justified on their own merits. However, each additional project becomes more difficult to justify as only residual damages are used in benefit analysis.

Comment: We question the failure to acknowledge adverse impacts on fishery resources, covered in other areas of your report.

Response: No adverse effects on the fishery resources are expected. However the Corps of Engineers in conjuntion with Federal and State Fish and Wildlife agencies will perform follow-up monitoring studies to verify expectations if the proposal is authorized.

6. The Skagit Regional Planning Agency.

Comment: The Skagit Regional Planning Agency had reviewed the Subject Draft Environmental Statement and concurs in general with the analysis and findings presented. We believe that the draft statement presents a fair statement of the facts as they exist at this time.

We further believe that the level of flood protection offered by a combination of the additional flood storage in Upper Baker, flood-plain management, and downstream levee and channel improvements is the minimum protection acceptable to the residents of the Skagit Valley.

Response: Acknowledged.

7. United States Department of the Interior, Bonneville Power Administration.

Comment: We offer no comments other than to address ourselves to the references to power losses as the result of additional flood control and the compensation therefore. We therefore suggest that you indicate in the appropriate places on pages iii, 56, and 69 that Bonneville Power Administration will be compensated for revenue forgone as a result of the power lost in providing additional flood control at Upper Baker Project.

Response: Comment acknowledged. Statements on pages iii, 56, and 69 of the draft EIS (page ii, sections 4.4.2 and 6.1.3 respectively in this final EIS) have been qualified with respect to your comment.

8. United States Department of the Interior, Bureau of Outdoor Recreation.

Comment: Pursuant to your request on February 26, 1975, we have reviewed the Draft Environmental Statement and Authorization Report on the Additional Flood Control at Upper Baker Project, Skagit River Basin, Skagit County, Washington. The draft statement adequately considers areas for which this Bureau has jurisdiction and review expertise; review of the authorization report reveals the proposal would have minimum impact on recreation facilities and opportunites.

Response: Comment acknowledged.

9. United States Department of the Interior, National Park Service.

Comment: We have reviewed the draft environmental statement and authorization report on the Additional Flood Control at Upper Baker Project, Skagit River Basin, Skagit County, Washington (ER-75/212).

We suggest that you consult the Washington State Historic Preservation Officer to determine if any sites eligible for the "National Register

of Historic Places" will be affected by the proposal. The results of this consultation should be reported and documented in the final statement.

Response: A telephone call was made on 15 May 1975 to Mr. David Hansen, Historic Preservationist with the Washington State Office of Archaeology and Historic Preservation. His evaluation is that the Baker Project will not impact any known Historical Sites in the region.

10. U.S. Environmental Protection Agency, Region X.

Comment: Outside of the benefits that should accrue to the project for flood control, no siginificant environmental impacts due to the proposal are forseen.

Our comments on this draft statement have been classified LO-1, LO (Lack of Objections) 1 (Adequate Information). The classification and the date of the Enviromental Protection Agency's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our review on proposed Federal actions under Section 309 of the Clean Air Act.

Response: Comments acknowledged.

11. United States Department of the Interior, Bureau of Reclamation.

Comment: We have reviewed the draft environmental impact statement and authorization report for Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington (ER 75/212). We have found no problems with the statement or report that would give rise to sinificant comment. Thank you for the opportunity of reviewing these statements.

Response: Comment acknowledged.

12. United States Department of Agriculture, Soil Conservation Service.

Comment: Page 41 (2.3.3.): Since "fallow generally connotates fields left uncropped during the growing season rather than those not seeded to a winter cover crop, perhaps "unprotected" might be a more appropriate term.

Response: The Final EIS has been revised under Section 2.3.3 to reflect the above qualification.

Comment: Pages ii, iii, 53: (Erosion due to drawdown.) Areas subject to rill erosion might be protected with diversions slightly above the normal maximum elevations. Erosion due to slumping, sliding, etc., are difficult to control when shorelines fluctuate.

Response: Because of existing geological conditions, we suspect that rill erosion would be very local in extent. We agree that erosion due to slumping and sliding is difficult to control, but we do not expect siginificant increases in such activity.

13. Department of Housing and Urban Development.

Comment: The Baker Dam Project is mentioned in the Comprehensive Land Use alternative for the Skagit River Floodplain prepared in April 1973. However, at the time you were in the process of investigation and the Regional Planning Council did not indicate whether they were for or against the project or if they considered the project as a potential to meet their overall floodplain management objectives. Thus, we think it important that their position be noted in your final statement.

Response: See comments of the Skagit Regional Planning Agency, (number 6, this section). The Baker Lake Project is an element in their overall floodplain management objectives and is supported by county citizens.

Comment: We would also like to know what geographic changes, if any, there would be in the 100-year floodplain.

Response: Because of the characteristics of the Skagit Basin and due to the limited reduction in flood stage (1 to 2 feet) made possible by the proposal, little change in the 100-year floodplain is expected.

14. United States Department of the Interior, Bureau of Indian Affairs.

Comment: A primary concern in the Skagit River Basin is the fishery resource. Assuming that the information concerning the resulting stream flow and spawning restrictions which will result from the lower drawdown of Upper Baker Reservoir is correct, it appears that the proposed flood control project will not diminish, and may enhance, the fishery environment. We feel it is very important to conduct future studies (as mentioned on page 53) to determine the impact upon Baker Lake spawners--and that the resulting data be used in future management and decision making.

Response: Comment acknowledged. Follow-up monitoring studies are programmed.

Comment: We depend upon the Fish and Wildlife Service for technical knowledge and analysis on fishery and related biologic resource matters. It would be appreciated if we could receive a copy of their comments for our files.

Response: A copy of the responses by the Department of the Interior, Fish and Wildlife Service has been sent as requested.

15. United States Department of Agriculture, Forest Service.

Comment: General Comments - The Skagit River is designated as a potential addition to the National Wild and Scenic River System under section 5 (a) of the Wild and Scenic Rivers Act. We are unable to determine the environmental impacts of each alternative considered to the potential wild and scenic river area. We recommend that the evaluation of environmental impacts consider the effects on the scenic, recreational and fish and wildlife values present in the potential river area.

Response: The Forest Service proposal to include the Skagit River System into the Wild and Scenic Rivers System and the environmental effects of the Baker Lake Project on this proposal is covered in Section 3.

Comment: If these rivers are added to the National Wild and Scenic River System, the future construction of flood control devices which would affect the free-flowing character of these rivers would be precluded. The proposed action is compatible with National System status for the Skagit. It is addressed and supported by our forthcoming draft environmental statement on the Skagit River Study. Such a discussion could be easily added to Section 3.0 on page 44.

Response: Comment acknowledged. Please see previous comment and response.

Comment: On page ii of the summary sheet, you first discuss drawdown from November 1-15. Near the bottom of the page you mention drawdown during "October and November". Drawdown should not occur until after the close of fishing season, normally October 31.

Response: Under present operating conditions, Baker Lake is normally drawn down from elevation 724.0 feet to about 721.0 feet during 1-30 October of each year. The proposal will not change this.

Comment: References to "Baker National Forest" on page 7 and "Mount Baker National Forest" on page 34, should be corrected to "Mt. Baker-Snoqualmie National Forest".

Response: Comment acknowledged. Suggested changes have been made in Sections 2.8 and 2.29 of the Final EIS.

Comment: On page 10, Section 2.12 - there are four developed Forest Service campgrounds and 12-14 undeveloped sites along Baker Lake, not two as the draft environmental statement states. You should also delete the word "area" after Glacier Peak Wilderness.

Response: The above information has been included in Section 2.12 of the Final EIS.

Comment: Reference on page ii of the summary sheet and page 60 of the DES discuss the exposure of a maximum of 12.8 feet of shoreline.

This is a vertical distance, which may be considerably greater on gently sloping shorelines. It should be noted that this exposure occurs at the worst time as far as shoreline erosion is concerned, since precipitation during this period normally occurs as rain, rather than non-erosive snow. The degree of impact might be placed in better perspective if the number of additional acres exposed could be quantified, and compared to the present acreage exposed in an average year.

Response: Final EIS has been revised to reflect lake level change of 12.8 feet.

16. State of Washington, Department of Ecology.

Comment: There appears to be a possible misunderstanding between the terms "flood-plain management" and "land-use control measures." Defining each term would make the difference more easily understood.

Response: Flood plain management includes land use controls as an element of the management program, along with early flood warning. Land use controls refer to the specific tools by which the county can implement flood plain management. These include: zoning, set-back requirements, building codes, sub-division regulations, etc.

Comment: Where structural measures are necessary to provide protection to existing development, it should be clear that land use and control measures are also necessary and required. This is to assure reduced flood damage on currently undeveloped land.

Response: Acknowledged. Section 3 of the Final EIS has been expanded to clarify the important relationship between structural flood control measures and land use control measures.

17. United States Department of the Interior, Geological Survey.

Comment: Page 9, second paragraph, sentence 1: This statement is generally true. However, recently Mt. Baker has shown increased activity and water in Boulder Creek, which drains an area near one of the new stream vents, has been reported to have a pH of near 3.7 and a specific conductance of about 500 micromhos.

Response: Final draft EIS under Section 2.10 has been expanded to reflect recent water quality studies conducted in Boulder Creek.

Comment: Page 52, first paragraph, lines 6 and 7: If "there is a potential for further reductions of present spawning..." then it would seem that redd losses would be increased.

Response: The wording of this sentence was awkward, leading to misinterpretation. The intent of the statement was to suggest that earlier drawdowns have the potential for decreasing redd losses during the sockeye salmon spawning season. The sentence has been revised

(section 4.3.5, this final EIS) to read: "Because the proposed plan would also result in earlier drawdowns than has been the case in the past, there exists the potential for further reduction in redd losses now experienced during sockeye salmon spawning season."

Comment: Page 70, first sentence: This sentence should emphasize that if levee and channel improvements are implemented, the improvement in flood protection would only occur in the river system downstream from Burlington. Flooding upstream from that point would probably still occur at a 2-3 year recurrence interval. This comment also applies to Avon Bypass (p. 70, b).

Response: Clarification of area protected by above projects has been made on page 42 of this final EIS.

18. United States Department of Commerce.

Comment: The State of Washington has indicated a desire to apply for an estuarine sanctuary grant under Section 312 of the Coastal Zone Management Act for Skagit Delta - Padilla Bay Area.

If the sanctuary was established, then future changes in flood control procedures could markedly alter flow rates and turbidity of the waters which may be detrimental to the objective of the estuarine sanctuary. We therefore suggest the Corps again contact the Department of Ecology of the State of Washington to insure that the State finds no conflict with their plans.

Response: The State of Washington Department of Ecology has reviewed the draft EIS and draft authorization report and concurs with its findings and recommendations.

19. Federal Power Commission.

Comment: We have not made an independant estimate of the energy and capacity loss incurred by the proposed plan (Alternative No. 3). We note that you have used power values furnished by this office to establish the alternative cost of replacement power for your economic evaluation. In this instance, the power values used reflect a nuclear power plant as an alternative source for the power foregone. This cost of alternative power, including annual administrative costs associated with the plan, is estimated to be $301,000 per year, to give the proposed plan a benefit-cost ratio of 4.8. Your DEIS does not, however, indicate the manner in which they were estimated. It is suggested that the method of computation of these power losses be indicated in the final environmental impact statement and in the final authorization report.

Response: Appendix 1, page F-3 of draft report discussed method of evaluating power losses and page F-4 presented computations of value of losses. Section 4.4.2 of the Final EIS has been expanded to include this information also.

Comment: Alternative No. 2 should be discussed in greater detail. In the absence of adequate coverage of the flood-plain management program without additional storage proposal, it is extremely difficult for the reader to determine whether or not the benefits derived from flood storage at Upper Baker would be significantly greater than those benefits derived from managing the use of the flood plain.

Response: The benefits from increased flood storage at Upper Baker Project were computed on the assumption of effective flood-plain management with and without the proposal. Benefits then are residual flood damages prevented. Benefits shown for flood-plain management, alone reflects damages prevented in the absence of Upper Baker Project (see Section 6.1.3).

Comment: The consequences of protracting the length of the flood while reducing its severity are mentioned (page 3) but are not throughly discussed. However, the length of the February 1951 flood (page 39) is cited as a significant contributor to the severity of flood damages. These two statements appear contradictory.

Response: For minor floods with flows approximately equal to the existing safe channel capacity the duration of flood discharge will not be appreciably increased over existing conditions. In the case of major floods the existing levee system will have been breached. Increased duration of flood stage would then not make much difference in damage levels.

Comment: We suggest that the DEIS discuss the effect, if any, of the proposed revised storage allocation on the hydro power production at the downstream Lower Baker project.

Response: The power loss analysis reflects effects at Lower Baker project as shown in Puget Sound Power and Light Company's letter included in Appendix 2 of draft authorization report. The effect was determined to be minor. Section 4.4.2 of Final EIS has been expanded to cover the methodology used in power loss computations.

20. Huxley College of Environmental Studies.

Comment: I have read the Draft Environmental Impact Statement relating to the proposed change in operation of Upper Baker Dam for flood control purposes. My analysis of the benefits derived from the protection of land, structures, and business operations in Skagit County indicate a varied spatial pattern of alleviated damages. Urbanized areas of Mt. Vernon and Burlington enjoy the greater proportion of these benefits. Since information concerning the areal differentiation in damage reduction is held in the Social and Economics Section, I suggest that a condensed summary of alleviated damages by specific areas within the floodplain be made available to the interested public.

Response: Presentation of flood control benefits by damage categories are discussed in the draft authorization report. Interested public can review detailed information on specific areas at Seattle District Office.

Comment: I go on now to an area of the EIS in which recent investigations and developments make quite critical the re-examination of the potential of large landslides entering the reservoir. Section 2.35, "Bank Sloughing", indicates intergovernmental coordination between the Seattle District and the U.S. Forest Service. I trust that your Engineering Division has been notified of the increased volcanic activity on the southeast slopes of Mt. Baker. Campsites will shortly be closed in the Mt. Baker-Snoqualmie National Forest, specifically Boulder Creek Campsite on the northwest shore of Baker Lake.

Scientific investigations of the occurrence of mudflows and rockslides associated with volcanic activity have been accomplished for Mt. Rainier and Mt. St. Helens of the Cascade Range. Currently scientists with the U.S. Geological Survey in Tacoma are preparing reports on the same subjects for the Mt. Baker Area. From personal communications of this past week, Bruce Foxworthy of the Urban Area Studies Section and Dr. Jack Hyde, consultant to the U.S.G.S. have been informed of the finalization of the Upper Baker Project Study. Their findings and tentative conclusions concerning the likelihood of large slides in the Upper Baker watershed should be solicited by your office and incorporated in any reanaylsis of the Project.

Response: Section 2.36 of the Final EIS has been expanded to document recent geothermal activity on Mt. Baker. Covered also in Section 4.3.9 are the expected impacts of geothermal activity on operation of the Upper Baker Dam.

21. The Issac Walton League of America.

Comment: From our review of the project report we concur the effect on the environment would be minimal. It also appears that there would be very little adverse effect on recreation.

The comments by the fishery, the wildlife environmental and recreational agencies seem to be appropriate and we concur with them. We have no further comments to offer.

Response: Comment acknowledged.

22. Washington Environmental Council.

Comment: Our primary concern over the proposed increase in flood-control storage is with its potential effect on land use in the Skagit River floodplain. The Skagit Regional Planning Council is quoted as recommending that "rural life style of the area and its attendant recreational opportunities be preserved." We concur and are concerned that

the flood-protection and flood-relief not indirectly destroy the present character of the Skagit Valley by encouraging a take-over by residential or commercial development. As the draft statement notes, such development could also negate the initial benefits of "structural" flood-control by increasing the number of lives and the value of property at risk.

Response: The Skagit Regional Planning Agency concurs with findings and recommendations of this study (see #6 this Section). Also Skagit County Commissioners at final public meeting (8 April 1975) agreed to implement flood-plain management portion of recommended plan thereby preventing unwise or undesirable development in flood hazard areas.

Comment: The proposed action would commit the Federal Government to long-term annual expenditures of real dollars to achieve projected savings in flood losses. The projected annual savings have soared from $300,000 to almost $1,500,000 since the "Public Brochure" of June 1973. Details of the methods used to make the projections, including the assumptions on future development in the flood plain, are lacking in the statement. These development assumptions should be made specific, with particular attention to the upset point at which further flood-plain development would reverse the favorable cost-benefit projections for providing increased Baker River flood storage.

Response: Final EIS is not intended to provide detailed information such as suggested. However, the Authorization Report documents the assumptions and methodology used in deriving flood damage reduction benefits. The report is available to the public.

Comment: Land-use control in the Skagit River floodplain is clearly essential to the long-term effectiveness of the proposed action in reducing flood losses. The draft environmental statement does not adequately address this issue. The recommendations of the Skagit Regional Planning Council are recommendations only and are not binding. The Skagit County flood-plain zoning ordinance does not prohibit future residential or commercial development in the flood plain. The draft statement notes that second-home construction along the river is increasing upstream of Lyman and that development pressure in the Skagit Valley can be expected to increase further because of the North Cascades Highway and the National Park. Against these observations it is asserted that future development pressures on the flood plain are likely to be "minimal" because of the limited protection offered by the increase in flood storage capacity at Baker Lake. Much second-home development is at least partially speculative and even a small reduction in flood frequency could encourage further subdivision. Public knowledge that increased Baker Lake flood storage could serve as the first step in a comprehensive flood-control plan for the Skagit must only increase the likelihood of speculative subdivision.

Response: Section 3 of the final EIS has been expanded to include further discussion of land-use control measures now used by Skagit County. As regards the Upper Baker Project, the relatively small increase in flood protection afforded by its implementation is not expected to generate significant land development pressures outside of those that now exist. Also, Skagit County Commissioners have agreed to control development in flood hazard areas as a precondition to implementation of this proposal.

Comment: The Skagit River is currently under study for inclusion in the National Wild and Scenic Rivers System. Any increase in speculative development activity would have an adverse effect on the acquisition of lands and easements should the Skagit be included in the system. The draft statement does not discuss this issue either.

Response: The final EIS has been expanded in section 3 to include a description of Forest Service proposals for Wild and Scenic River Status for the Skagit, and the potential environmental effects of the Baker Lake Project on these proposals.

Comment: The appended June 1973 "Public Brochure" states that Federal participation in flood-control measures "may be made conditional upon completion of zoning and other flood-plain management activities by local authorities." The efficacy of the proposed increase in flood storage capacity at Baker Lake is dependent on such activity. We, therefore, recommend that the increase be made conditional on binding agreements by all the competent local jurisdictions to institute and maintain land-use controls that will keep flood-plain development within the levels necessary to preserve a favorable cost-benefit ratio.

Response: Skagit County has furnished a letter of intent to control development in flood hazard areas, and to annually inform residents of the basin of the true flood hazard.

Comment: We also recommend that increased storage not be implemented until the inclusion of the Skagit in the National River System is resolved.

Response: Action on both the Upper Baker and Wild and Scenic River proposals is a responsibility of Congress. As the Forest Service has already indicated the Upper Baker proposal is consistent with their recommendations, there appears to be no reason why increased flood control could not be implemented before classification.

Comment: In conclusion, we note that the proposed action is closely related to other proposed flood-control and flood-damage reduction measures in the Skagit River basin. We believe that a comprehensive environmental statement should be prepared for all these measures considered as a system, of which the lowering of

Baker Lake is the initial element. Land-use planning must precede this system to ensure that it does not destroy the resources it intends to protect.

Response: The other proposals are included in the comprehensive Water and Related Land Resources Plan prepared by the Pacific Northwest River Basins Commission for Puget Sound and Adjacent Waters for which an environmental impact statement is on file at CEQ. Each of these projects, of course, will require a separate EIS if and when they are further studied and proposed for implementation.

23. Seattle Audubon Society.

Comment: The draft EIS is slightly ambiguous as to what the effects of the reduced flooding frequency might be on flood-plain development. On the one hand, it is suggested that a sense of additional security may lead to increased flood-plain development and greater personal and economic losses. On the other hand, it is simply stated that flood-plain development would be expected to be minimal. How can one expect this to be the case?

Response: The achievement of greater flood protection has the potential of attracting and encouraging more extensive development in flood-plain areas, especially in those areas located close to existing urban centers. However, owing to the limited amount of increased protection offered by the Baker Lake project, any future development occurring as a result is expected to be minimal. So while there is a potential for further development, it is not expected to be great.

Comment: By what means will implementation of an adequate flood-plain management scheme be ensured if it is decided that additional flood control storage will be provided? Since much of the Skagit shoreline has been so attractive to summer home development upstream and other types of development downstream, the effects of additional flood storage plus an inadequate flood-plain management program or none at all could ultimately lead to greater economic losses. Would additional flood storage only be implemented contingent on an adequate program? What power does the Skagit Regional Planning Council have to implement adoption of their regulations concerning flood-plain management?

Response: Authority for effective flood-plain and shoreline management rests with Skagit County and the State of Washington. All recent activities of both give every indication that development is and will continue to be regulated in flood-hazard areas.

Comment: How will increased landslide activity and increased siltation and turbidity in the lake affect the life and water quality in Baker Lake and the waters downstream? To what extent will these increase the rate of filling of the lake and the reduction of the volume of water held by the lake? Perhaps maximum and minimum figures on this would be helpful.

Response: Our studies indicate that although downstream waters may increase slightly in turbidity because of earlier lakeshore exposure, this condition is not expected to be great enough to pose a threat to life or to pose a potential water quality problem. Likewise, we expect that the proposed pool operation change will have little effect on landsliding, sloughing or erosion. Therefore, little change in downstream water quality is anticipated from this source.

Comment: Probably the worst feature of this proposal and the one which might make early drawdown uneconomical in the long run is the resulting loss of hydroelectric power. It is stated in the draft EIS that this "would contribute cumulatingly to future power shortages which may justify construction of new generating facilities." If this is in fact the case, then the impacts of this project have not been fully outlined in this report. The environmental impact of building any sort of new generating facility would be far-reaching and undoubtedly quite costly. It seems that this cost has not been taken into account in calculating the cost-benefit ratio. With sky-rocketing energy prices, it is probable that the costs will increase at a greater rate than the benefits making the additional flood storage an uneconomical addition to flood-plain management.

Response: The power losses were computed on basis of the least-costly alternative for providing replacement power and, therefore, the benefit-cost ratio reflects the worst-case condition. BPA has indicated it can provide the replacement power from the existing Federal system at about 1/6 the annual cost used in the economic analysis. While theorectically it is true new generation would be required to cover the lost capacity at Upper Baker Project; in reality, the amount lost is so small it can be easily absorbed by the systemm. New plants are constructed with 1,000 megawatts capacity compared to the maximum power loss of 6.3 megawatts expected at Upper Baker Project.

Comment: Upon examining the cost benefit ratios for alternatives 2 and 3, it is not clear how the average annual costs for alternative 3 are derived. It seems they should be roughly equal to the sum of costs for alternative 2 (zoning, permits, proofing, insurance) plus the cost of the additional flood control storage (Federal power revenues foregone, cost of replacement power, etc.) It would be helpful to show more clearly how the figure, $642,000 is derived.

Response: The average annual cost figure of $642,000 shown in the preliminary draft EIS and public brochure No. 4 for alternative 3 was arrived at by summing the average annual cost for alternative 2 ($341,000) and the cost of additional storage at Upper Baker project ($301,000). In our final report the costs were updated to reflect changed power values. The average annual cost for alternative 3, (including the costs of flood-plain management) are shown as $775,000 of which $341,000 are costs of flood-plain management and $434,000 power loss and administrative costs associated with changed flood control operation at Upper Baker Project.

Comment: Several other questions arise. It is mentioned that assessed land values may rise with increased flood protection. Will this have the effect of crowding any farmers out?

Response: Because of the relatively small increase in overall flood protection resulting from additional flood control at Upper Baker project, the actual impact on assessed valuation is not expected to be great. Consequently, we do not expect any significant increase in agricultural land assessment values in the study area that can be attributed to the Upper Baker project.

Comment: What would the effects of lengthening the duration of the heaviest floods be?

Response: Assuming the "heaviest floods" to correspond to 50- or 100-year floods, then the proposed action of the Upper Baker project will not have much of an effect. Once levees are overtopped and land and improvements are damaged, the slight increase of a few hours in flood duration will not significantly change damage levels.

Comment: Will there be any change in the fertility of the flood plain due to less frequent flooding?

Response: Agricultural practices in the Skagit River flood plain depends upon large scale use of fertilizers. Past experience has shown that after a flood, larger quantities of fertilizers are usually required to compensate for leaching and soil dilution effects. Over the long term, a slight decrease in fertilizer usage may occur.

24. Washington Department of Fisheries.

Comment: Par. 3.b., pg. ii. The EIS refers to an exposure of 12.8 feet of shoreline which represents a vertical reduction in lake level of 12.8 feet. Much more than 12.8 feet of shoreline would be exposed along those sections of shoreline which are sloping, the amount of exposure dependent on the shore gradient. At lower elevations, much of the shoreline is not vertical. This statement does not give a clear picture of shoreline exposure.

Response: Final EIS has been revised to clarify that 12.8 feet is a lake level change.

Comment: Sec. 2.10. Lake spawning for sockeye is not successful because of the receding water levels in Baker Lake during the fall and winter.

Response: Section 2.10 has been revised to include the above information.

Comment: Sec. 4.3.3. No mention is made of the effect of increased temperatures on the rate of egg incubation.

Response: Because any increase in temperature is expected to be minor, no effect should occur on rate of egg incubation. Please see section 4.3.3 of this final EIS.

Comment: Sec. 4.3.5. With the drawdown starting November 1, little relief would be expected for lakeshore-spawning sockeye. Spawning in the artificial spawning beaches is about 1/3 completed by November 1 and our experience with sockeye in Channel Creek is that sockeye maturing in Baker Lake spawn about 2 weeks ahead of artificial beach spawners. Spawning in Channel Creek is not spread out over the long period of time as is the artificial beach spawning. Therefore, most spawning in the lake would be completed by November 1.

Response: Follow-up monitoring studies will provide factual data to enable full evaluation of effects of earlier drawdown. No benefits have been claimed, however, but merely the potential indicated.

Comment: If future studies by fisheries agencies regarding the impact of the proposed drawdown schedule show an unanticipated adverse impact on beach-spawning sockeye, provision should be made to implement Fisheries' alternative plan or a similar plan.

Response: See response above. Should unanticipated adverse effects occur, drawdown schedule would be re-evaluated.

Comment: Sec. 4.4.1. There is considerable spawning in the mainstem Skagit below Concrete during the October 1-November 15 drawdown period. The additional discharge from the Baker project may encourage spawning in areas which may be dewatered when discharge is reduced after November 15. This would mean facing the problem of redd loss in the mainstream Skagit as well as Baker Lake.

Response: The addition of an overage flow increase of 1,900 c.f.s. from the Baker project to the Skagit River will represent a total flow increase of only 12 percent in the mainstream Skagit. Because of this relatively small increase, we do not expect significant changes in downstream water levels, thereby reducing the risk of dewatering downstream spawning areas after 15 November.

Comment: Sec. 5.1. Comments on paragraph 3.b., pg. ii apply here also.

Response: See above response.

25. Washington Department of Social and Health Services.

Comment: The statement intimates an increase in flood-plain development at elevations afforded added protection by the proposed project, suggesting a desperate need for public sewers to alleviate the adverse impact on water quality. Development most assuredly will occur in the absence of restrictive statutes; however, it is presumptuous to justify flood-plain development by a reduction in flood hazard. The impact of unavoidable flooding on the economic, mental and physical well-being of flood victims and associated infrastructure is immeasurable. We do not support the encouragement of flood-plain development under any circumstance and recommend that flood control projects be preceded by mandated land-use restrictions.

Response: Skagit County, through its Flood-Plain Management responsibilities, has initiated action to control development in flood prone areas. There is no reason to believe that with the implementation of the Baker project, county control will be any less effective. In fact, because of required commitments of local sponsor (Skagit County), management measures should be more effective.

Comment: The impact of increased reservoir drawdown on insect vector propagation has not been discussed by the authors. Vector control measures for shoreline and slough areas should be given in-depth consideration.

Response: Earlier drawdown should have minimal or no effects on insect vector propagation in the Baker Lake area. As figure 1 shows, although earlier drawdown will result in a lower pool than usual during 1-15 November, the minimum pool level as recommended in our proposal is still within the past pool range elevations of previous years.

26. Washington Parks and Recreation Commission.

Comment: However, as a point of information, it appears that an error has been made on page ii-3b and on page 54-4.3.8. It is stated that a 12.8 or 13 foot vertical drop in the water level will cause about 12.8 or 13 feet of shoreline exposure. This could happen only when the bottom of the lake is a vertical cliff. If the average side slope of the lake bottom near the edge of the lake were 3 to 1, then a vertical drop of about 13 feet would expose about 39 feet, not 13 feet of lake bottom.

89-280 O - 77 - 24

Response: Comment acknowledged. Subject references have been clarified to reflect a lake level change of 12.8 feet.

27. Washington State Highway Commission.

Comment: We have completed our review with respect to existing or proposed highways in the area and find no conflicts.

Response: Comment acknowledged.

9.5 Letters of Comment on Draft EIS. The letters received in comment to the draft EIS are reproduced in full starting on page 79 opposite.

9.6 Letters of Comment on Revised Draft EIS. Comments on the revised draft EIS are found below. For copies of the letters received please see page 120.

28. United States Department of the Interior.

Comment: Inasmuch as the additional drawdown of Baker Lake Reservoir will occur during the typically wet month of November, the frequency and magnitude of flooding that may occur locally on Baker River below the dam should be assessed.

Response: No water will be released for additional drawdown if the Baker River below Lower Baker Dam is forecast to exceed zero damage flows.

Comment: The statement should discuss at least in general terms the downstream changes in ground-water levels and in ground-water/surface-water inter-relationships that can be anticipated as a result of the changes in storage and release patterns at the reservoir. Examination of the proportion of the Skagit River flows contributed by Baker River suggests that it is signifcant and related effects on ground water should be noticeable.

Response: From the analysis presented in Paragraph 4.3.2, Velocities, we point out that increased flows from Baker Lake drawdowns will not significantly increase total flows and velocities in the main stream Skagit River. The additional flow increase which will occur will have little, if any, effect on river stage, and consequently little effect on ground-water levels and discharges.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

OREGON STATE OFFICE
P.O. Box 2965 (729 N.E. Oregon Street)
Portland, Oregon 97208

IN REPLY REFER TO:
1792 (911)

MAR 18 1975

District Engineer
U. S. Army Corps of Engineers
Seattle, Washington

Gentlemen:

We have reviewed the draft Environmental Impact Statement and Authorization Report for Additional Flood Control at the Upper Baker Project, Skagit River Basin, Skagit County, Washington, and we offer the following comments:

There are numerous unsurveyed islands in the Skagit River below its confluence with the Baker River and several others in Skagit Bay at the river mouth which are under BLM administration. We do not believe, though, that the proposed project will have any adverse impacts on BLM programs or plans for these Natural Resource Lands.

The Skagit River upstream from the town of Mt. Veron has been declared by the Congress as a study river for possible inclusion in the National Wild and Scenic Rivers System (PL 90-542 of 10-2-1968).

Since the proposed project will withhold water from or release water to the Skagit River, depending on the flood control cycle, the effect of the project on the possible addition to the National Wild and Scenic Rivers System should be discussed. The statement should show positive evidence of correlating this project with the scenic rivers study being conducted by the Forest Service, the lead agency for the study.

Sincerely yours,

E. J. Peterson

Acting State Director

Advisory Council
On Historic Preservation
[illegible] Street N.W. Suite 430
Washington D.C. 20005

MAR 2 0 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Corps of Engineers, Seattle District
Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

This is in response to your request of February 28, 1975 for comments on the draft environmental statement for the proposed Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that your draft environmental statement appears adequate regarding our area of expertise and we have no further comment to make at this time.

Sincerely yours,

John D. McDermott
Director, Office of Review
and Compliance

United States Department of the Interior
BUREAU OF MINES
EAST 315 MONTGOMERY AVENUE
SPOKANE, WASHINGTON 99207

Western Field Operation Center
March 31, 1975

Mr. Sidney Steinborn, Chief
Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way S.
Seattle, Washington 98134

Dear Mr. Steinborn:

Personnel in this office have reviewed the Draft Environmental Statement and Authorization Report on the Additional Flood Control at Upper Baker project, Skagit River basin, Skagit County, Washington (ER-75/212).

The proposed modification in the operation of Upper Baker Dam and Reservoir for flood control purposes would not adversely affect mineral development in the Skagit River basin. Both documents adequately discuss the basin's mineral resources commensurate with the proposed action.

We offer the following suggestions for your consideration. The environmental statement should include any adverse or beneficial impacts as they relate to the proposed Skagit River Wild and Scenic River. The Forest Service provided information from the study (Authorization Report, page A-3), but a direct reference could not be found in the statement.

The statement does not mention the proposed Skagit Nuclear Power Project located just north of the river between Sedro Woolley and Lyman. Will the project have any adverse or beneficial effects upon the proposed power project?

Increased steam venting has occurred recently from Mt. Baker. Should this increase in venting activity continue or foreshadow a general increase in volcanic activity, the results could have a great impact upon the downstream Baker River system. Such impacts as avalanches and sudden release of waters from debris dams should be discussed in this environmental statement. One of the latest references

to the increase in geothermal activity is "Recurrent Geothermally Induced Debris Avalanches on Boulder Glacier, Mt. Baker, Washington" by David Frank, Austin Post, and Jules D. F. Friedman, Journal of Research, U.S. Geological Survey, January-February 1975, Volume 3, No. 1, pp. 77-87. Further references are listed in this paper.

These comments are intended only to provide preliminary review and technical assistance and do not constitute a formal Department of the Interior or Bureau of Mines response.

Sincerely yours,

R. N. Appling, Jr., Chief
Western Field Operation Center

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1500 N.E. IRVING STREET
P.O. BOX 3737
PORTLAND, OREGON 97208

Reference: RB

April 2, 1975

District Engineer
Seattle District, Corps of Engineers
4735 E Marginal Way South
Seattle, Washington 98134

Dear Sir:

We have reviewed your draft environmental statement and authorization report on Additional Flood Control at Upper Baker project, Skagit River Basin, Skagit County, Washington, in response to Mr. Sydney Steinborn's February 26 letter to the Department's Office of Environmental Project Review. As instructed by the Department, we are providing the following comments directly to you covering items within our areas of jurisdiction and expertise.

Page 8, Section 2.10, Fisheries and Wildlife Resources (Draft statement). Steelhead fishing is mentioned as outstanding in Skagit River. Other important fish and wildlife values, including waterfowling on Skagit Flats, and salt water salmon fishing should be included. Economic values for fish and wildlife resources should also be stated as those for agriculture.

Page 11, Section 2.13, Land Use (Draft statement). Land use with associated water requirements in Skagit County should include fish and wildlife.

We appreciated the opportunity to comment on your draft statement.

Sincerely yours,

D. H. Reese

Acting Regional Director

Director / Carl N. Crouse

Assistant Directors / Ralph W. Larson
Ronald N. Andrews

Game Commission

Arthur S. Coffin, Yakima, Chairman
James R. Agen, LaConner
Elmer G. Gerken, Quincy
Claude Bekins, Seattle
Glenn Galbraith, Wellpinit
Frank L. Cassidy, Jr., Vancouver

DEPARTMENT OF GAME

600 North Capitol Way / Olympia, Washington 98504

April 2, 1975

U. S. Army Corps of Engineers
Seattle District
4735 East Marginal Way
Seattle, Washington

Gentlemen:

Your draft environmental impact statement - Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington - was reviewed by our staff as requested. Our comments follow.

Our primary concern is that the final impact statement include assessment of Baker Lake resident game fish and associated project impact. Only a "basin" species list is included at present (page 8). All analyses in terms of project impacts are for sockeye salmon. Consequently, all discussion of the proposed project are deficient, both in terms of fisheries and recreation. Specific discussion on this point follows, along with other comments on fish and wildlife.

Project Description

Consideration of timing of reservoir filling and how this will be affected by the proposed project is needed.

The report states additional flood control storage is to be available until 1 March, then filling "would begin and usually be complete by 1 April". (page ii, paragraph 1). Later the statement says filling "can" begin after March with "target date of 1 April" (page 2, paragraph 1). It goes on to say filling in "some" years "might" be later due to hydrologic conditions. This is very vague; clarification is needed in the final report.

In the past, reservoir filling was not complete until as early as May or as late as July (plates F-1 through F-5, Corps Authorization Report and/or Figure 1, DEIS). This presently may or may not be damaging some fish.

Filling too early (i.e., before emergence of Dolly Varden and kokanee fry) could adversely affect spawning success by slack-water inundation of spawning areas. If the reservoir is drawn down further than is the current practice, this could result in adverse impact on kokanee or Dolly Varden, depending on where they spawn.

Late lake filling could adversely affect rainbow and cutthroat by encouraging spawning in stream areas that are later inundated. Since only small numbers of cutthroat and rainbow "natives" apparently exist in Baker Lake, this may be happening now. But data on spawning time and locations is needed to make a conclusive statement on this one way or the other. In summary, late lake filling could be advantageous for fall spawners (Dolly Varden and kokanee) but could be detrimental to spring spawners (rainbow and cutthroat trout).

Consideration of the relationship between project proposal and maximum drawdown for power generation is also needed. You stated, in part, "Alternative 3 proposes... holding the reservoir below elevation 707.9 feet... additional storage would be available... from 15 November to 1 March..." (page 2, paragraph 1). How far below elevation 707.8 feet would the reservoir be drafted as opposed to present conditions? We expect that drawdowns more severe or lengthly than presently experienced will adversely affect carrying capacity and productivity of the lake.

Environmental Setting Without the Project

You may wish to mention the following information on Baker Lake's resident fishery in the Fisheries and Wildlife Resources section (pages 8-10). Kokanee, Dolly Varden, rainbow, and cutthroat trout are all present in Baker Lake as self-sustaining populations (legal rainbows are reared and released for a put-and-take fishery, as you have stated). Kokanee are the most important species present; they sustain the largest naturally-produced harvest by far. Dolly Varden are harvested in smaller numbers but achieve "trophy size" and are specifically sought after by some anglers. Self-sustaining rainbow and cutthroat populations are small and contribute little to overall harvest.

The 1971 Baker Lake Creel Census (James Cummins, WDG, Dec. 1971) reported an estimated catch of 9,826 rainbow trout from a plant of 55,000 catchable size fish, 10,658 kokanee and 1,524 miscellaneous species - a total of 21,998 fish for the census period (July 1 through September 6, 1971). The survey showed the average angler fished 2.94 hours and caught 2.73 fish per trip (1.21 rainbow and 1.40 kokanee; average catch per trip.). This yielded a total projected time of 25,538 man hours of fishing during the census period.

Many of the types of wildlife which may use Baker Lake and surrounding region are mentioned in this section. Swan should be added. You may also wish to mention that osprey nesting is reported in the east shore of Baker Lake. Baker Lake vicinity probably supports a fair number of ruffed grouse and a good population of raccoon (Brown, Judith, Fish and Wildlife Resources of Mount Baker National Forest, Applied Research Bul. No. 2., Mar. 1974, WDG, pages 41, 42, 48).

Environmental Impact of the Proposed Action

In addition to information on impacts on Baker Lake's resident fishery requested above, we suggest the final impact statement also include a discussion of project effect on turbidity conditions in Lower Baker and Skagit Rivers.

Future studies to determine extent of impacts on Baker Lake spawners, if the proposed plan is implemented, are mentioned on page 53. We suggest the scope of the study be expanded to include resident game fish stocks which heretofore appear to have been overlooked.

Your assessment of effects on wildlife resources (page 53) addresses effects which may be sustained at Baker Lake. A decrease in open water space available to waterfowl will be experienced; you may wish to mention this also. Secondary impacts on wildlife should be acknowledged. The proposal seeks to provide additional flood protection to nearly 100,000 acres of floodplain and thus opens a potential (however small) for increased loss of wildlife resources existing in this floodplain area. The proposal will also help pave the way for stream and channel improvements and the Avon Bypass, projects which may result in adverse impacts on fish and wildlife.

Unavoidable Adverse Environmental Impacts

We question the failure to acknowledge adverse impacts on fishery resources, covered in other areas of your report.

Thank you for sending your draft and providing us an opportunity to comment. We hope our comments will be helpful.

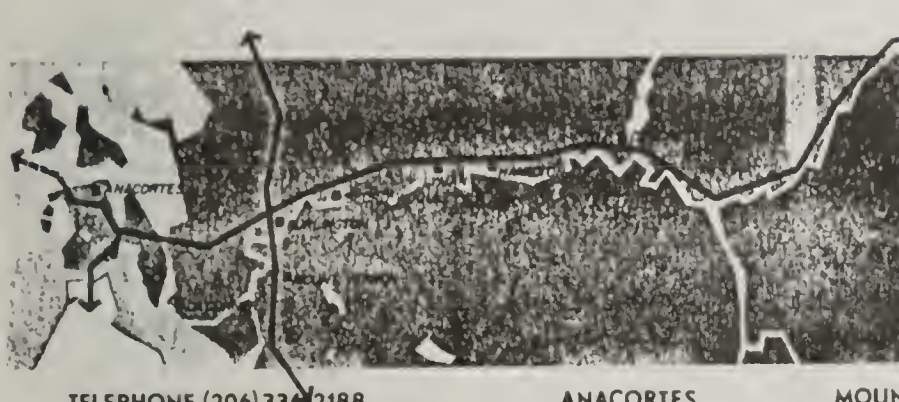
Sincerely,

THE DEPARTMENT OF GAME

E. S. Dziedzic

Eugene S. Dziedzic, Asst. Chief
Environmental Management Division

ESD:jb
cc: E. A. Chitwood
Agencies



SKAGIT REGIONAL PLANNING COUNCIL

TELEPHONE (206) 336-2188
120 W. KINCAID, ANNEX II
MOUNT VERNON, WASH. 98273

ANACORTES
BURLINGTON
LA CONNER

MOUNT VERNON
PORT OF ANACORTES
PORT OF SKAGIT COUNTY

SEDRO-WOOLLEY
SKAGIT COUNTY
SKAGIT P.U.D. NO. 1

April 3, 1975

Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Attention: Mr. Jim Newman
Environmental Coordinator

Subject: Draft Environmental Statement
additional Flood Control
Upper Baker Project
Skagit River Basin, Washington

The Skagit Regional Planning Agency has reviewed the Subject Draft Environmental Statement and concurs in general with the analysis and findings presented. We believe that the draft statement presents a fair statement of the facts as they exist at this time.

We further believe that the level of flood protection offered by a combination of the additional flood storage in Upper Baker, flood-plain management, and downstream levee and channel improvements is the minimum protection acceptable to the residents of the Skagit Valley.

Thank you for the opportunity to offer these comments.

Sincerely,

Robert C Schofield

Robert C. Schofield, Executive Director
SKAGIT REGIONAL PLANNING COUNCIL

United States Department of the Interior

BONNEVILLE POWER ADMINISTRATION
P.O. BOX 3621, PORTLAND, OREGON 97208

OFFICE OF
THE ADMINISTRATOR

In reply refer to: AJ

APR 7 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

Thank you for the opportunity to review your draft environmental impact statement on Additional Flood Control at Upper Baker Project.

We offer no comments other than to address ourselves to the references to power losses as the result of additional flood control and the compensation therefor. We recently raised a similar question with reference to the draft public brochure on this subject in a letter dated March 27, 1975, to Mr. Frank J. Urabeck. The letter, a copy of which is attached, explains our concerns. Mr. Urabeck communicated his appreciation of the problem to Mr. Kropitzer of this office and graciously agreed to reflect our comments in the public brochure. We therefore suggest that you indicate in the appropriate places on pages iii, 56, and 69 that Bonneville Power Administration will be compensated for revenue forgone as a result of the power lost in providing additional flood control at Upper Baker Project.

Sincerely yours,

Donald Paul Hodel

Administrator

Enclosure:
Letter of March 27, 1975, to Mr. Urabeck

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
NORTHWEST REGION

IN REPLY REFER TO:

E3027
ER-75/212

[redacted]

Sydney Steinborn, Chief
Engineering Division
Department of the Army
Seattle District Corps of
Engineers
4735 E. Marginal Way So.
Seattle, Washington 98134

Dear Mr. Steinborn:

Pursuant to your request of February 26, 1975, we have reviewed the Draft Environmental Statement and Authorization Report on the Additional Flood Control at Upper Baker Project, Skagit River Basin, Skagit County, Washington. The draft statement adequately considers areas for which this Bureau has jurisdiction and review expertise; review of the authorization report reveals the proposal would have minimum impact on recreation facilities and opportunites.

Sincerely yours,

Maurice H. Lundy
Regional Director

United States Department of the Interior

NATIONAL PARK SERVICE

Pacific Northwest Region
Fourth and Pike Building
Seattle, Washington 98101

IN REPLY REFER TO:

L7619
(PNR)CAE

April 9, 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

We have reviewed the draft environmental statement and authorization report on the Additional Flood Control at Upper Baker Project, Skagit River Basin, Skagit County, Washington (ER-75/212).

We suggest that you consult the Washington State Historic Preservation Officer to determine if any sites eligible for the "National Register of Historic Places" will be affected by the proposal. The results of this consultation should be reported and documented in the final statement.

Sincerely yours,

Glenn D. Gallison
Associate Regional Director,
Cooperative Activities

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: 10RA0FA - M/S 623

April 9, 1975

Mr. Frank Urabeck, Study Manager
Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Urabeck:

We have reviewed the draft environmental impact statement on, "Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington."

This project merely proposes to utilize a portion of the existing storage space in PSP&L's Upper Baker River Project for flood control. The only change in current operation is that the reservoir will be intentionally drawn down in late fall to make flood storage available through the winter and early spring months. Power revenues foregone will be replaced at the expense of the Federal Government.

Outside of the benefits that should accrue to the project for flood control, no significant environmental impacts due to the proposal are foreseen.

Our comments on this draft statement have been classified LO-1, LO (Lack of Objections) 1 (Adequate Information). The classification and the date of the Environmental Protection Agency's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our review on proposed Federal actions under Section 309 of the Clean Air Act.

Thank you for the opportunity to review this draft statement.

Sincerely,

Walter D. Jaspers

Walter D. Jaspers
Director
Office of Federal Affairs

United States Department of the Interior
BUREAU OF RECLAMATION

PACIFIC NORTHWEST REGIONAL OFFICE
FEDERAL BUILDING & U.S. COURTHOUSE
BOX 043 - 550 WEST FORT STREET
BOISE, IDAHO 83724

IN REPLY
REFER TO: 160

120.1

APR 10 1975

District Engineer
Seattle District, Corps of Engineers
Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Sir:

We have reviewed the draft environmental impact statement and authorization report for Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington (ER 75/212). We have found no problems with the statement or report that would give rise to significant comment. Thank you for the opportunity of reviewing these statements.

Sincerely yours,

H. R. Stiles

Assistant Regional Director

cc: Commissioner, Attn: 150
Director, Office of Environmental Project Review, USDI, WDC

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Room 360 U.S. Courthouse, Spokane, Washington 99201

April 10, 1975

Sydney Steinborn
Chief, Engineering Division
Department of the Army
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Sir:

Your draft environmental impact statement on Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington was reviewed by our specialists. Inasmuch as the draft is concerned with flood control rather than the vegetative or agricultural aspects or related effects, our comments relate to those areas within our expertise.

Page 41 (2.3.3.): Since "fallow generally connotates fields left uncropped during the growing season rather than those not seeded to a winter cover crop, perhaps "unprotected" might be a more appropriate term.

Pages ii, iii, 53: (Erosion due to drawdown.) Areas subject to rill erosion might be protected with diversions slightly above the normal maximum elevations. Erosion due to slumping, sliding, etc., are difficult to control when shorelines fluctuate.

The other information relative to affected soils appears to be adequately addressed.

If we can be of further assistance to you on these or other projects, please let us know. The opportunity to review your draft is appreciated.

Sincerely,

Galen S. Bridge
State Conservationist

89-260 O - 77 - 25

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
ARCADE PLAZA BUILDING, 1321 SECOND AVENUE
SEATTLE, WASHINGTON 98101

April 10, 1975

REGION X

Office of Community
Planning and Development

IN REPLY REFER TO:

10D

Mr. Jim Newman
Environmental Coordinator
Seattle District Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Newman:

Subject: Draft Environmental Statement Additional Flood Control at Upper Baker Project

We have reviewed the statement submitted with your February 26, 1975 letter requesting comments by April 14th.

The proposed action is to increase the flood control storage space at the Upper Baker Reservoir from 16,000 acre feet to an additional 58,000 acre feet by increasing the reservoir drawdown during November 1 to November 15 of each year.

The Baker Dam Project is mentioned in the Comprehensive Land Use alternative for the Skagit River Floodplain prepared in April 1973. However, at the time you were in the process of investigation and the Regional Planning Council did not indicate whether they were for or against the project or if they considered the project as a potential to meet their overall floodplain management objectives. Thus, we think it important that their position be noted in your final statement.

We would also like to know what geographic changes, if any, there would be in the 100 year floodplain.

We defer to other agencies to comment on other aspects of your project not within our jurisdiction or expertise. Thanks for the opportunity to comment.

Sincerely,

James L. Young
Regional Administrator

IN REPLY REFER TO:
Land Services

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
PORTLAND AREA OFFICE
POST OFFICE BOX 3785
PORTLAND, OREGON 97208

APR 30 1975

Mr. Sidney Steinborn
Chief, Engineering Division
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

This is in reference to your draft environmental statement and authorization report on the additional flood control at Upper Baker Project, Skagit River Basin, Skagit County (ER 75/212).

A primary concern in the Skagit River Basin is the fishery resource. Assuming that the information concerning the resulting stream flow and spawning restrictions which will result from the lower draw-down of Upper Baker Reservoir is correct, it appears that the proposed flood control project will not diminish, and may enhance, the fishery environment. We feel it is very important to conduct future studies (as mentioned on page 53) to determine the impact upon Baker Lake spawners--and that the resulting data be used in future management and decision making.

We depend upon the Fish and Wildlife Service for technical knowledge and analysis on fishery and related biologic resource matters. It would be appreciated if we could receive a copy of their comments for our files.

Sincerely yours,

Assistant Area Director
(Economic Development)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Region 6
P.O. Box 3623, Portland, Oregon 97208

8420
April 11, 1975

Mr. Sydney Steinborn
Chief, Engineering Division
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

At your request we have reviewed the draft environmental statement on Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington. Our comments follow:

1. General Comments - The Skagit River is designated as a potential addition to the National Wild and Scenic River System under section 5 (a) of the Wild and Scenic Rivers Act. We are unable to determine the environmental impacts of each alternative considered to the potential wild and scenic river area. We recommend that the evaluation of environmental impacts consider the effects on the scenic, recreational and fish and wildlife values present in the potential river area.

   If these rivers are added to the National Wild and Scenic River System, the future construction of flood control devices which would affect the free-flowing character of these rivers would be precluded. The proposed action is compatible with National System status for the Skagit. It is addressed and supported by our forthcoming draft environmental statement on the Skagit River Study. Such a discussion could be easily added to Section 3.0 on page 44.

2. On page ii of the summary sheet, you first discuss drawdown from November 1-15. Near the bottom of the page you mention drawdown during "October and November". Drawdown should not occur until after the close of fishing season, normally October 31.

3. References to "Baker National Forest" on page 7 and "Mount Baker National Forest" on page 34, should be corrected to "Mt. Baker-Snoqualmie National Forest".

4. On page 10, Section 2.12 - there are four developed Forest Service campgrounds and 12-14 undeveloped sites along Baker Lake, not two as

the draft environmental statement states. You should also delete the word "area" after Glacier Peak Wilderness. The same comment is valid for page 12 of the authorization report and B-10 of Appendix 1.

5. Reference on page ii of the summary sheet and page 60 of the DES discuss the exposure of a maximum of 12.8 feet of shoreline. This is a vertical distance, which may be considerably greater on gently sloping shorelines. It should be noted that this exposure occurs at the worst time as far as shoreline erosion is concerned, since precipitation during this period normally occurs as rain, rather than non-erosive snow. The degree of impact might be placed in better perspective if the number of additional acres exposed could be quantified, and compared to the present acreage exposed in an average year.

6. Page 5 of the Appendix should be corrected to read "National Wild and Scenic River System."

We appreciate the opportunity to review you D.E.S. and trust our comments will assist you in preparing the final statement.

Sincerely,

FOR T.A. SCHLAPFER
Regional Forester

State of Washington
Department of Ecology

April 14, 1975

Raymond J. Eineigl
Colonel, U.S. Army Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Subject: Upper Baker Project, Skagit River Basin

Dear Colonel Eineigl:

We have reviewed the Draft Authorization Report, Public Brochure and the Draft Environmental Impact Statement for the Upper Baker Project, Skagit River Basin and concur with the findings and recommendation contained therein.

As you are aware, the Department of Ecology is designated by Governor Evans to represent the State on these matters. In a coordinated review we have found no opposition to the recommended alternative and find that it will generally increase multiple-objective benefits (except for minor power losses).

Attached are comments on the Draft EIS that may be of assistance to you in preparing your final statement.

We, therefore, encourage early implementation of Alternative Three-Flood Plain Management with additional flood control storage at the Upper Baker Project.

Sincerely,

John A. Biggs
Director
Department of Ecology

JAB:JWS:tg
Attachment
bc: Denny Lundblad ✓
Ed Hammersmith
Duane Wegner
Skagit County Planning Office

April 14, 1975

Department of Ecology Comments:

U.S. Army Corps of Engineer's
Draft Environmental Impact Statement
Additional Flood Control
at Upper Baker Project
Skagit River Basin, Washington

Thank you for the opportunity to review your document. It appears to be an excellent presentation of the proposed action thus indicating considerable forethought in its preparation.

The comments we have are as follows:

1. There appears to be a possible misunderstanding between the terms "flood plain management" and "land use control measures." Defining each term would make the difference more easily understood.

2. Where structural measures are necessary to provide protection to existing development, it should be clear that land use and control measures are also necessary and required. This is to assure reduced flood damage on currently undeveloped land.

We hope the comments will be helpful to you. If we can be of further service to you, please contact Mr. David Thompson of our Environmental Review Section.

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

ER-75/212

APR 15 1975

Mr. Sydney Steinborn, Chief
Engineering Division
Seattle District
Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

We have reviewed the draft environmental impact statement on Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington, and the draft authorization report, as you requested in a letter of February 26 to the Office of Environmental Project Review. We offer the following comments for your consideration.

Environmental impacts related to geologic conditions are adequately discussed in the environmental statement.

We find the subject documents to be adequate and generally accurate in their assessment of the impact of the proposed actions on water resources of the area. However, we submit the following specific comments.

Draft Environmental Statement

Page 9, second paragraph, sentence 1: This statement is generally true. However, recently Mt. Baker has shown increased activity and water in Boulder Creek, which drains an area near one of the new steam vents, has been reported to have a pH of near 3.7 and a specific conductance of about 500 micromhos.

Page 52, first paragraph, lines 6 and 7: If "there is a potential for further reductions of present spawning . . ." then it would seem that redd losses would be increased.

Page 70, first sentence: This sentence should emphasize that if levee and channel improvements are implemented, the improvement in flood

protection would only occur in the river system downstream from Burlington. Flooding upstream from that point would probably still occur at a 2-3 year recurrence interval. This comment also applies to Avon Bypass (p. 70, b).

Authorization Report

Page 28: We suggest that the table be titled "Historical Skagit River Floods near Mt. Vernon."

Appendix 1, C-22, Table C-4: For the Skagit River near Concrete, the "crest discharge" should be 139,000 cfs.

We thank you for the opportunity to review and comment on these documents.

Sincerely yours,

Keeling Director

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

April 21, 1975

Mr. Sydney Steinborn
Chief, Engineering Division - Seattle District
Corps of Engineers
U. S. Department of the Army
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

The draft environmental impact statement "Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington," which accompanied your letter of February 26, 1975, has been received by the Department of Commerce for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

GENERAL COMMENTS

The Department of Commerce, Office of Coastal Zone Management, finds the subject document adequately describes the project, the means of coordination, and the alternatives to the project.

The State of Washington has indicated a desire to apply for an estuarine sanctuary grant under Section 312 of the Coastal Zone Management Act for Skagit Delta - Padilla Bay Area.

If the sanctuary was established, then future changes in flood control procedures could markedly alter flow rates and turbidity of the waters which may be detrimental to the objective of the estuarine sanctuary. We therefore suggest the Corps again contact the Department of Ecology of the State of Washington to insure that the State finds no conflict with their plans.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving two copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

FEDERAL POWER COMMISSION
REGIONAL OFFICE
555 BATTERY STREET, ROOM 415
SAN FRANCISCO, CALIF. 94111

April 23, 1975

Col. Raymond J. Eineigl
District Engineer
Seattle District, Corps of Engineers
4735 East Marginal Way
Seattle, WA 98134

Dear Sir:

We have reviewed your Draft Environmental Impact Statement and the Draft Authorization Report on the Additional Flood Control at Upper Baker Project, which were furnished with your letter of February 26, 1975.

These comments on your Draft Environmental Impact Statement by the San Francisco Regional Office of the Federal Power Commission's Bureau of Power are made in accordance with the National Environmental Policy Act of 1969, and the August 1, 1973, Guidelines of the Council on Environmental Quality. Our principal concern with developments affecting land and water resources is the possible effect of such development on bulk electric power facilities, including existing and potential hydroelectric developments, and on natural gas pipeline facilities. The action proposed in this draft statement affects the operation of a Federal Power Commission licensed project.

Your proposed plan would modify the present operation of the Upper Baker Reservoir, which is part of FPC Licensed Project No. 2150, by providing for 58,000 additional acre-feet of flood control storage by increasing reservoir drawdown during the period November 1-15 of each year. Pool elevation during this drawdown period would be reduced from about elevation 720.6 feet to elevation 707.8 feet. The additional flood control storage obtained would be available until March 1 of each year, when refilling would begin, and normally be completed April 1. You have estimated that the proposed plan would result in a capacity loss of up to 6.3 megawatts, and an energy loss of 1.117 average megawatts annually.

The present operation of the Upper Baker Reservoir provides for 16,000 acre-feet of space for flood regulation between November 1 and March 1, as specified by the Project License. Article 32 of the License further provides for up to a maximum of 84,000 acre-feet of flood control space in the reservoir during the storage drawdown season, as may be requested by the Corps of Engineers, provided suitable arrangements are made to compensate the Licensee.

We have not made an independent estimate of the energy and capacity loss incurred by the proposed plan (Alternative No. 3). We note that you have used power values furnished by this office to establish the alternative cost of replacement power for your economic evaluation. In this instance, the power values used reflect a nuclear power plant as an alternative source for the power foregone. This cost of alternative power, including annual administrative costs associated with the plan, is estimated to be $301,000 per year, to give the proposed plan a benefit-cost ratio of 4.8. Your DEIS does not, however, indicate the manner in which the power losses were estimated. It is suggested that the method of computation of these power losses be indicated in the final environmental impact statement and in the final authorization report.

The proposed plan would provide for reimbursement to Puget Sound Power & Light for the power losses through replacement power from the Bonneville Power Administration. Your estimated annual cost of this power is $80,000. As previously noted, the FPC license for the project allows for additional flood control space in the Upper Baker Reservoir, provided that suitable arrangements shall have been made to compensate the Licensee.

Alternative No. 2 should be discussed in greater detail. In the absence of adequate coverage of the flood plain management program without additional storage proposal, it is extremely difficult for the reader to determine whether or not the benefits derived from flood storage at Upper Baker would be significantly greater than those benefits derived from managing the use of the flood plain.

The consequences of protracting the length of the flood while reducing its severity are mentioned (page 3) but are not thoroughly discussed. However, the length of the February 1951 flood (page 39) is cited as a significant contributor to the severity of flood damages. These two statements appear contradictory.

We suggest that the DEIS discuss the effect, if any, of the proposed revised storage allocation on the hydro power production at the downstream Lower Baker project.

On page C-3, Appendix 1 of the Authorization Report, the installed capacity shown for Lower Baker should be changed from 103,000 kilowatts to 64,000 kilowatts. This revised capacity is due to the abandonment of two powerhouse units following severe landslide damage in 1965.

Very truly yours,

Deputy

(Acting for) M. Frank Thomas
Regional Engineer

HUXLEY COLLEGE OF ENVIRONMENTAL STUDIES
A DIVISION OF WESTERN WASHINGTON STATE COLLEGE

April 22, 1975

Mr. Frank J. Urabeck
Study Manager - Upper Baker Project
Department of the Army
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington

Dear Mr. Urabeck:

I have read the Draft Environmental Impact Statement relating to the proposed change in operation of Upper Baker Dam for flood control purposes. My analysis of the benefits derived from the protection of land, structures, and business operations in Skagit County indicates a varied spatial pattern of alleviated damages. Urbanized areas of Mt. Vernon and Burlington enjoy the greater proportion of these benefits. Since information concerning the areal differentiation in damage reduction is held in the Social and Economics Section, I suggest that a condensed summary of alleviated damages by specific areas within the floodplain be made available to the interested public.

I go on now to an area of the EIS in which recent investigations and developments make quite critical the reexamination of the potential of large landslides entering the reservoir. Section 2.35, "Bank Sloughing," indicates intergovernmental coordination between the Seattle District and the U.S. Forest Service. I trust that your Engineering Division has been notified of the increased volcanic activity on the southeast slopes of Mt. Baker. Campsites will shortly be closed in the Mt. Baker-Snoqualmie National Forest, specifically Boulder Creek Campsite on the northwest shore of Baker Lake.

Scientific investigations of the occurrence of mudflows and rockslides associated with volcanic activity have been accomplished for Mt. Rainier and Mt. St. Helens of the Cascade Range. Currently scientists with the U.S. Geological Survey in Tacoma are preparing reports on the same subjects for the Mt. Baker Area. From personal communications of this past week, Bruce Foxworthy of the Urban Area Studies Section and Dr. Jack Hyde, consultant to the U.S.G.S. have been informed of the finalization of the Upper Baker Project Study. Their findings and tentative conclusions concerning the likelihood of large slides in the Upper Baker watershed should be solicited by your office and incorporated in any reanalysis of the Project.

Sincerely,

Rodney G. Sakrison
Teaching Assistant
Environmental Planning

RGS/kf

BELLINGHAM, WASHINGTON 98225 · AREA CODE 206 676-3520

The Izaak Walton League of America

INCORPORATED

BUILDING A BETTER OUTDOOR AMERICA

April 15, 1975

District Engineer
Seattle District, Corps of Engineers
4735 East Marginal Way South
Seattle, Washington 98134

Dear Gentlemen:

Thank you for your letter of February 26, 1975 regarding the upper Baker Project, Skagit River Basin. We appreciate the opportunity to review your proposed report on the Project.

As is described in your report the proposal is to draw the reservoir down approximately 13 feet during October and November to provide 58,000 acre feet of additional flood control storage during the winter months. Before it would normally be drawn down for the generation of hydro power.

From our review of the project report we concur the effect on the environment would be minimal. It also appears that there would be very little adverse effect on recreation.

The comments by the fishery, the wildlife environmental and recreational agencies seem to be appropriate and we concur with them. We have no further comments to offer.

Sincerely,

Larry L. Petersen

Larry L. Petersen
President
Greater Seattle Chapter
of the Izaak Walton
League of America

LLP:dsp

WASHINGTON ENVIRONMENTAL COUNCIL

107 SOUTH MAIN, SEATTLE, WA. 98104 / 623-1483

AAUW
Allied Arts Council
Alps - Ellensberg
AIA
AIP
Cascade Wilderness Club
Citizens Against Freeways
CARHT
Clean Air for Washington
Coalition Against Oil Pollution
Committee for Holly Environment
Concerned about Trident
Cougar Lake Wilderness Alliance
Earth Care Organization
East Side League
Environmental Committee on Survival
Environmental Qual Coun
Everett JC's
Evergreen Fly Fishing Club
Hood Canal Env. Council
Intermountain Alpine Club
Junior League of Seattle
Junior League of Spokane
King Co. Conservation Education Com.
Lake Stickney Garden Club
Lance Belfair
Lower Col. Audubon Society
Marine Technology Society
Montlake Community Club
The Mountaineers
North Cascades Conservation Council
Northwest Steelheaders
Nisqually Delta Assoc.
Oak Harbor Garden Club
Olympic Park Assoc.
Olympic Peninsula Audubon Society
Oroville Sportsmen's Assoc.
Pacific County Env. Coun.
Pierce County Action
Pilchuck Audubon Society
Planned Parenthood Center
Poggie Club of Washington
Progressive Animal Welfare Society
Protect the Peninsula's Future
The Ptarmigans
Puget Sound Beach Preservation
Puget Sound Fly Fishing Club
Puget Sound Mycological Society
Pullman League of Women Voters
Queen Anne Garden Club
Ravenna Community Assoc.
Richland Rod and Gun Club
Save Cypress Island Comm.
Seattle Audubon Society
Seattle Garden Club
Seattle JC's
Seattle Veterinary Med Assoc.
Shoreline League
Sierra Club - PNW
Skagit Alpine Club
Salty Beachcombers Club
SW Wash Env. Action Team
Spokane Mountaineers
Spokane Audubon Society
Steelhead Trout Club
Tahoma Audubon Society
Thurston Action Committee
Wash. Alpine Club
Wash Assoc. of College Biology Teachers
Wash. Assoc. of Sanitarians
Wash. Kayak Club
Wash. Roadside Council
Wash. Fed. of Garden Clubs
Wash. Recreation and Trails Assoc.
Wash. State Labor Council
Yakima River Conservancy
Zero Population Growth

April 17, 1975

Army Corps of Engineers, Seattle District
4735 East Marginal Way South
Seattle, Washington 98134

Dear Mr. Steinborn:

Thank you for the opportunity to review and comment upon the draft environmental statement, "Additional Flood Control at Upper Baker Project, Skagit River Basin, Washington."

Our primary concern over the proposed increase in flood-control storage is with its potential effect on land use in the Skagit River floodplain. The Skagit Regional Planning Council is quoted as recommending that "the rural life style of the area and its attendant recreational opportunities be preserved." We concur and are concerned that the flood-protection and flood-relief not indirectly destroy the present character of the Skagit Valley by encouraging a take-over by residential or commercial development. As the draft statement notes, such development could also negate the initial benefits of "structural"

flood-control by increasing the number of lives and the value of property at risk.

The proposed action would commit the Federal Government to long-term annual expenditures of real dollars to achieve projected savings in flood losses. The projected annual savings have soared from $300,000 to almost $1,500,000 since the "Public Brochure" of June 1973. Details of the methods used to make the projections, including the assumptions on future development in the floodplain, are lacking in the statement. These development assumptions should be made specific, with particular attention to the upset point at which further floodplain development would reverse the favorable cost-benefit projections for providing increased Baker River flood storage.

Land-use control in the Skagit River floodplain is clearly essential to the long-term effectiveness of the proposed action in reducing flood losses. The draft environmental statement does not adequately address this issue. The recommendations of the Skagit Regional Planning Council are recommendations only and are not binding. The Skagit County floodplain zoning ordinance does not prohibit future residential or commercial development in the floodplain. The draft statement notes that second-home construction along the river is increasing upstream of Lyman and that development pressure in the Skagit Valley can be expected to increase further because of the North Cascades Highway and the National Park. Against these observations it is asserted that

future development pressures on the floodplain are likely to be "minimal" because of the limited protection offered by the increase in flood storage capacity at Baker Lake.

Much second-home development is at least partially speculative and even a small reduction in flood frequency could encourage further subdivision. Public knowledge that increased Baker Lake flood storage could serve as the first step in a comprehensive flood-control plan for the Skagit must only increase the likelihood of speculative subdivision.

The Skagit River is currently under study for inclusion in the National Wild and Scenic Rivers System. Any increase in speculative development activity would have an adverse effect on the acquisition of lands and easements should the Skagit be included in the system. The draft statement does not discuss this issue either.

The appended June 1973 "Public Brochure" states that Federal participation in flood-control measures "may be made conditional upon completion of zoning and other floodplain management activities by local authorities." The efficacy of the proposed increase in flood storage capacity at Baker Lake is dependent on such activity. We therefore recommend that the increase be made conditional on binding agreements by all the competent local jurisdictions to institute and maintain land-use controls that will keep floodplain development within the levels necessary to preserve

a favorable cost-benefit ratio. We also recommend that increased storage not be implemented until the inclusion of the Skagit in the National River System is resolved. In conclusion, we note that the proposed action is closely related to other proposed flood-control and flood-damage reduction measures in the Skagit River basin. We believe that a comprehensive environmental statement should be prepared for all these measures considered as a system, of which the lowering of Baker Lake is the initial element. Land-use planning must precede this system to ensure that it does not destroy the resources it intends to protect.

Sincerely,

Martin Baker

Martin Baker
Executive Director

1014 NE 61 St.
Seattle, WA 98115
9 April 1975

Raymond J. Eineigl
District Engineer
Seattle District Corps of Engineers
4735 East Marginal Way S.
Seattle, WA 98134

Dear Colonel Eineigl:

Upon reviewing the environmental impact statement for the Upper Baker Project, a number of questions and problems arise related to the proposed action. As a result of these, we would like to recommend a more careful evaluation and consideration of alternative 2 (Flood Plain Management Alone). In the long run, this may be the most valuable economically, as I will point out.

The draft EIS is slightly ambiguous as to what the effects of the reduced flooding frequency might be on flood plain development. On the one hand it is suggested that a sense of additional security may lead to increased flood plain development and greater personal and economic losses. On the other hand, it is simply stated that flood plain development would be expected to be minimal. How can one expect this to be the case?

By what means will implementation of an adequate flood plain management scheme be ensured if it is decided that additional flood control storage will be provided? Since much of the Skagit shoreline has been so attractive to summer home development upstream and other types of development downstream the effects of additional flood storage plus an inadequate floodplain management program or none at all could ultimately lead to greater economic losses. Would additional flood storage only be implemented contingent on an adequate program? What power does the Skagit Regional Planning Council have to implement adoption of their regulations concerning flood plain management?

How will increased landslide activity and increased silt ation and turbidity in the lake affect the life and water quality in Baker Lake and the waters downstream? To what extent will these increase the rate of filling of the lake and the reduction of the volume of water held by the lake? Perhaps maximum and minimum figures on this would be helpful.

Probably the worst feature of this proposal and the one which might make early drawdown uneconomical in the long run is the resulting loss of hydroelectric power. It is stated in the draft EIS that this "would contribute cumulatingly to future power shortages which may justify construction of new generating facilities." If this is in fact the case, then the impacts of this project have not been fully outlined in this report. The environmental impact of building any sort of new generating facility would be far-reaching and undoubtedly quite costly. It seems that this cost has not been taken into account in calculating the cost-benefit ratio. With sky-rocketing energy prices it is probable that the costs will increase at a greater rate than the benefits making the additional flood storage an uneconomical addition to flood plain management.

Upon examining the cost benefit ratios for alternatives 2 and 3, it is not clear how the average annual costs for alt. 3 are derived. It seems they should be roughly equal to the sum of costs for alternative 2 (zoning, permits, proofing, insurance) plus the cost of the additional flood control storage (federal power revenues forgone, cost of replacement power.etc.) It would be helpful to show more clearly how the figure, $642,000, is derived.

Several other questions arise. It is mentioned that assesed land values may rise with increased flood protection. Will this have the effect of crowding any farmers out? What would the effects of lengthening the duration of the heaviest floods be? Will there be any change in the fertility of the floodplain due to less frequent flooding?

Taking into consideration many of the points raised above, it appears that flood plain management alone would provide much-needed relief with mostly positive environmental impacts, while the addition of extra storage in Baker Lake would add significant negitive impacts and increase the economic benefits only slightly (and perhaps not at all in the long run). While alternative 3 would be far superior to alternatives such as a dam on the Sauk or channel "improvement" on the Skagit, it would contribute to environmental deterioration and would perhaps lead to other more devastating projects such as the two such mentioned. Flood plain management alone would be a good long term solution. With the proper controls, uses of the flood plain would eventually all conform to the natural geologic processes that occurs there and the ongoing war against the river would no longer be necessary.

We hope these points will be considered in the final environmental impact statement.

Sincerely,

Doug Wechsler

Doug Wechsler
Conservation Committee
Seattle Audubon Society

ROOM 115, GENERAL ADMINISTRATION BUILDING • PHONE 753-6600
OLYMPIA, WASHINGTON 98504

April 22, 1975

Mike Mills
State Planning Division
Office of Program Planning
and Fiscal Management
Olympia, Washington 98504

Dear Mr. Mills:

The Washington Department of Fisheries offers the following comments on the Draft Environmental Impact Statement, Upper Baker Project:

Par. 3.b., pg. ii. The EIS refers to an exposure of 12.8 feet of shoreline which represents a vertical reduction in lake level of 12.8 feet. Much more than 12.8 feet of shoreline would be exposed along those sections of shoreline which are sloping, the amount of exposure dependent on the shore gradient. At lower elevations much of the shoreline is not vertical. This statement does not give a clear picture of shoreline exposure.

Sec. 2.10. Lake spawning for sockeye is not successful because of the receding water levels in Baker Lake during the fall and winter.

Sec. 4.3.3. No mention is made of the effect of increased temperatures on the rate of egg incubation.

Sec. 4.3.5. With the drawdown starting November 1, little relief would be expected for lakeshore-spawning sockeye. Spawning in the artificial spawning beaches is about one-third completed by November 1 and our experience with sockeye in Channel Creek is that sockeye maturing in Baker Lake spawn about two weeks ahead of artificial beach spawners. Spawning in Channel Creek is not spread out over the long period of time as is the artificial beach spawning. Therefore, most spawning in the lake would be completed by November 1.

If future studies by fisheries agencies regarding the impact of the proposed drawdown schedule show an unanticipated adverse impact on beach-spawning sockeye, provision should be made to implement Fisheries' alternative plan or a similar plan.

Sec. 4.4.1. There is considerable spawning in the mainstem Skagit below Concrete during the October 1-November 15 drawdown period. The additional discharge from the Baker Project may encourage spawning in areas which may be dewatered when discharge is reduced after November 15. This would mean facing the problem of redd loss in the mainstem Skagit as well as Baker Lake.

Sec. 5.1. Comments on paragraph 3.b., pg. ii apply here also.

We appreciate the opportunity to review and comment on this draft statement.

Very truly yours,

Donald W. Moos
Director

April 2, 1975

State of Washington
Department of Social & Health Services

Mr. Mike Mills
State Planning Division
House Office Building
Olympia, WA 98504

RE: Draft Environmental Impact Statement
Additional Flood Control at Upper
Baker Project

Dear Mr. Mills:

We have reviewed the referenced statement and deduce that the project's socio-economic and public health impacts have been inadequately addressed.

The statement intimates an increase in flood plain development at elevations afforded added protection by the proposed project, suggesting a desperate need for public sewers to alleviate the adverse impact on water quality. Development most assuredly will occur in the absence of restrictive statutes, however, it is presumptuous to justify flood plain development by a reduction in flood hazard. The impact of unavoidable flooding on the economic, mental and physical well-being of flood victims and associated infrastructure is immeasurable. We do not support the encouragement of flood plain development under any circumstance and recommend that flood control projects be preceded by mandated land use restrictions.

The impact of increased reservoir drawdown on insect vector propagation has not been discussed by the authors. Vector control measures for shoreline and slough areas should be given in-depth consideration.

Sincerely,

John H. Laubach

John H. Laubach, R.S.
Administrative Consultant
Office of Environmental Health Programs

JHL/lr

69-260 O - 77 - 26

GOVERNOR
DANIEL J. EVANS

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EUSTACE VYNNE
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DIRECTOR:
CHARLES H. ODEGAARD

WASHINGTON STATE
PARKS & RECREATION COMMISSION

LOCATION: THURSTON AIRDUSTRIAL CENTER PHONE 753-5755

P. O. BOX 1128 OLYMPIA, WASHINGTON 98504

March 11, 1975

IN REPLY REFER TO:

TO: Mike Mills, State Planning Division, Office of Program Planning and Fiscal Management

FROM: David W. Hauser, Chief, Environmental Coordination

David Hansen, Chief of Archaeology and Historic Preservation

RE: DRAFT ENVIRONMENTAL IMPACT STATEMENT - ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT

The Washington State Parks and Recreation Commission has reviewed the above-noted document and can find no adverse impact on existing or proposed recreational areas under the jurisdiction of the Commission.

However, as a point of information, it appears that an error has been made on page ii-3b and on page 54-4.3.8. It is stated that a 12.8 or 13 foot vertical drop in the water level will cause about 12.8 or 13 feet of shoreline exposure. This could happen only when the bottom of the lake is a vertical cliff. If the average side slope of the lake bottom near the edge of the lake were 3 to 1, then a vertical drop of about 13 feet would expose about 39 feet, not 13 feet of lake bottom.

Thank you for the opportunity to review and comment on this statement.

sg

WASHINGTON STATE
HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

Highway Administration Building
Olympia, Washington 98504 (206) 753-6005

April 1, 1975

Mr. Mike Mills
State Planning Division
Office of Program Planning and Fiscal Management
106 House Office Building
Olympia, Washington 98504

Corps of Engineers
Additional Flood Control at Upper Baker Project
Draft Environmental Statement

Dear Mr. Mills:

Reference is made to your letter of March 5, requesting our review of the draft environmental statement for the above project.

We have completed our review with respect to existing or proposed highways in the area and find no conflicts.

Thank you for the opportunity to review this information.

Sincerely,

G. H. ANDREWS
Director of Highways

By: H. R. GOFF
Assistant Director for
Planning, Research and State Aid

HRG:eh
RA/RBD

cc: W. C. Bogart

State of
Washington
Department
of Ecology

June 9, 1976

Lieutenant General W. C. Gribble, Jr.
Chief Engineer
Office of Chief Engineer
U. S. Army Corps of Engineers
Washington D. C. 20314

Dear General Gribble:

In reference to your letter dated March 3, 1976, (78-534), we have reviewed the Authorization Report and the Revised Environmental Statement for the Upper Baker Project, Skagit River Basin, and concur with the findings and recommendations contained therein.

We, therefore, encourage early implementation of Flood Plain Management with additional flood control storage at the Upper Baker Project.

Sincerely,

John A. Biggs, Director

JAB:sm

cc: Washington Congressional Delegation
Senator Jennings Randolph

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

3 June 1976

Lieutenant General W. C. Gribble, Jr.
Chief of Engineers
Department of the Army
Washington, D. C. 20314

Dear General Gribble:

This is in response to your letter of 3 March 1976 addressed to Secretary Coleman concerning a revised environmental impact statement on the Upper Baker Project, Skagit River Basin, Skagit County, Washington.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

D. J. FINLEY
Captain, U. S. Coast Guard
Acting Chief, Office of Marine
Environment and Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: 10FA - M/S 623

April 20, 1976

Colonel Marvin W. Rees
Executive Director of Civil Works
Department of the Army
Office of the Chief of Engineers
Washington, D. C. 20314

Dear Colonel Rees:

We have reviewed the revised draft environmental impact statement prepared by the U.S. Army Corps of Engineers on Upper Baker Project, together with our original comments of April 9, 1975 on this project, and find that our original conclusion that the proposal would result in no significant environmental impacts remains unchanged.

Our comments on this revised draft statement have been classified LO-1, LO (Lack of Objections) 1 (Adequate Information). The classification of the Environmental Protection Agency's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act.

Thank you for the opportunity to review and comment on this revised draft statement.

Sincerely yours,

Francine K. Duncan

Francine K. Duncan
Acting Director
Office of Federal Affairs

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

6 May 1976

Lieutenant General W. C. Gribble, Jr.
Chief of Engineers
Department of the Army
Washington, D.C. 20314

Reference: DAEN-CWP-A

Dear General Gribble:

This is in reply to your letter of March 3, 1976, inviting comments by the Commission relative to your proposed report and to the reports of the Board of Engineers for Rivers and Harbors and of the District and Division Engineers on additional flood control at the Upper Baker project, Skagit River Basin, Washington. A revised draft environmental impact statement accompanied the reports.

The cited reports recommend modification in the operation of the existing Upper Baker project, owned and operated by the Puget Sound Power and Light Company, to provide 58,000 acre-feet of additional flood control storage capacity on a seasonal basis. The estimated annual flood damage reduction benefits are $1,127,000, and the estimated annual economic costs, consisting for the most part of the value of power (capacity and energy) losses, are $434,000. The Puget Sound Power and Light Company would be compensated with power, in kind, from the existing Federal power system. The Bonneville Power Administration estimated the annual cost of replacement power at $56,000.

The Commission staff has reviewed the economics of the proposal. Using a range of power values generally applicable to the Pacific Northwest and the Company's estimate of power losses, 6,300 kilowatts of dependable capacity and 1,117 kilowatts of average energy, the staff analysis indicates that the $1,127,000 annual flood control benefits estimated by your Department would substantially exceed the value of

the power lost and also far exceed the cost of replacement power generated within the Federal system. Consequently, it is apparent that the proposal would be economically justified by a wide margin.

As discussed in the material furnished, the Upper Baker project is licensed by the Federal Power Commission as part of Project No. 2150. Article 32 of the license specifies that 16,000 acre-feet of flood control storage capacity will be provided in the Upper Baker Reservoir as replacement for the valley storage eliminated by the development. Article 32 further states that: "In addition to the above-specified 16,000 acre-feet, the licensee shall provide in the Upper Baker River Reservoir space for flood control during the storage drawdown season (about September 1 to April 15) up to a maximum of 84,000 acre-feet as may be requested by the District Engineer, provided that suitable arrangements shall have been made to compensate the licensee for the reservation of flood control space other than the 16,000 acre-feet specified herein." According to the reports of your Department, the licensee and the Bonneville Power Administration have generally agreed to the concept of reimbursement.

Based on its consideration of the reports of your Department, the draft environmental impact statement, and the studies of its own staff, the Commission concludes that the proposed modification in operation of the Upper Baker project would be economically justified, and that the proposals for modification and for the compensation to the project owner therefor are consistent with the project's Federal Power Commission license conditions.

Sincerely yours,

Richard L. Dunham
Chairman

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Policy
Washington, D.C. 20230

6 August 1976

John A. Poteat
Colonel, Corps of Engineers
Department of the Army
Office of the Chief of Engineers
Washington, D.C. 20314

Dear Colonel Poteat:

Secretary Richardson has asked me to reply to you concerning the Department of Commerce comments on the Corps of Engineers' authorization report for additional floor control at Upper Baker Project, Skagit River Basin, Washington.

We appreciated the extension of the review period that you granted and we will make every effort in the future to see that such extensions are not necessary.

Overall, the departmental comments were favorable on the report. However, some technical questions were raised which I have summarized and enclosed with this letter.

Thank you for the opportunity to make these comments.

Sincerely,

Robert S. Milligan

Robert S. Milligan
Deputy Assistant Secretary
for Policy Development
and Coordination

Enclosure

Office of Regional Economic Coordination

The proposed plan seems to be properly justified.

On p. 22, it is claimed that the expected flood damages will average $4,246,000 annually (1974 prices). Yet, on the previous page, a table of historical flood damages for the past 55 years provides data that indicate an average annual flood loss of $3,000,000 (in 1973 prices). Some explanation should be given of why the 1974-price loss level is so much above the historical figure. Note that Appendix 1 (pp. F-4 to F-20) explains in some detail how that $4,246,000 annual figure is derived. But this discussion did not recognize or attempt to reconcile the difference from the historical annual loss values.

National Oceanic and Atmospheric Administration
National Weather Service

The Office of Hydrology made the following comments:

On page 18, under the heading "Status of Existing Plans and Improvements," the following statement should be included: "The River and Flood Forecast and Warning program of the National Oceanic and Atmospheric Administration presently provides flood forecasts and warnings for the communities of Concrete and Mt. Vernon."

On page 42, under the heading "Selected Plan Description," the following statement should be included as item f: "Flood forecasts and warnings provided by the National Oceanic and Atmospheric Administration's National Weather Service."

On page 50, under the heading "Division of Plan Responsibilities," the following sentence should be added to the first paragraph: "The National Oceanic and Atmospheric Administration will continue to provide flood forecasts and warnings for the Skagit River Basin as required."

National Marine Fisheries Service

The Corps of Engineers Authorization Report for Additional Flood Control at Upper Baker Project, Skagit River, Washington was discussed with State and Federal agencies. A prior review of the project completed in May-June 1974, indicated a concern about sockeye salmon redd dewatering in Baker Lake. NMFS recommended that flood control drawdown commence one day after Labor Day and be completed by October 1. This plan would deter adults from spawning at higher elevations and subsequent redds from being dewatered.

The Corps of Engineers in response to this plan, indicated that sockeye salmon redds are dewatered under present Baker Dam operations and that the proposal for additional flood control storage had the potential of reducing redd losses by limiting the occurrence of spawning in areas that become dry every year. The Corps also stated that "the FPC license is specific as to the provision for additional flood control."

Additionally, NMFS recommended that "to maximize a deterrent to sockeye beach spawning within the October 1 to November 15 time frame, the drawdown be made at a constant rate in terms of reservoir elevation during this period."

NMFS plans no further action at this time, but will continue coordination with State and Federal fishery agencies if needed.

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

2 June 1976

Lt. General W. C. Gribble, Jr.
Chief of Engineers
Office of the Chief of Engineers
Department of the Army

Dear General Gribble:

This is in response to your letter of March 3, 1976, to Secretary Butz transmitting for our review and comments your proposed report with pertinent papers and a revised draft environmental impact statement for the Upper Baker Project, Skagit River Basin, Washington.

We have reviewed the report and have three comments for your consideration:

1. It would be desirable to include more detail in the discussion of agricultural flood damages in appendix 1, section P. Some data on land use, yields and production with and without the plan would give local people, planners, and researchers a better understanding of plan impacts on agriculture.

2. Footnote 5, table 1, p.33, should be rewritten to make it clear that the same benefits were not counted twice for alternative 2, once as flood damages prevented and again as reduction in flood insurance payments.

3. A full reference should be given for the study by Resources for the Future, Inc., mentioned on p. F-17.

The revised environmental impact statement includes responses to comments made by our state conservationist on the February 26, 1975, draft. We have no further substantive comments.

Thank you for providing this report and environmental impact statement for our review.

Sincerely,

ROBERT W. LONG
Assistant Secretary

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

OFFICE OF THE SECRETARY

WASHINGTON, D.C. 20201

AUG 19 1976

Lieutenant General John W. Morris
Chief of Engineers
U.S. Army Corps of Engineers
Forrestal Building
Washington, D.C. 20314

Dear General Morris:

Thank you for your request concerning our response to the Upper Baker Project, Skagit River Basin, Washington and the Lower Snake River Fish and Wildlife Compensation Plan, Lower Snake River, Washington. The Department has not reviewed these documents and, to my knowledge, does not plan to review them.

Sincerely,

Paul Cromwell
Acting Director
Office of Environmental Affairs

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/237

8 June 1976

Dear General Gribble:

Thank you for the letter of March 3, 1976, requesting our views and comments on the revised draft environmental statement and authorization report for Upper Baker Project, Skagit River Basin, Skagit and Whatcom Counties, Washington. We have reviewed the documents and conclude that they adequately consider those areas within our jurisdiction and expertise, except for several suggestions offered below.

Environmental Statement

Inasmuch as the additional drawdown of Baker Lake Reservoir will occur during the typically wet month of November, the frequency and magnitude of flooding that may occur locally on Baker River below the dam should be assessed.

The statement should discuss at least in general terms the downstream changes in ground-water levels and in ground-water/surface-water inter-relationships that can be anticipated as a result of the changes in storage and release patterns at the reservoir. Examination of the proportion of the Skagit River flows contributed by Baker River suggests that it is significant and related effects on ground water should be noticeable.

We are pleased to note that our comments on the first draft statement have been satisfactorily addressed in the revised document.

Authorization Report

We find that the information contained in the document accurately describes the recommended plan, alternative plans, and other project features. The data and recommendations conform with our previous understanding of the project.

We conclude that change in operation of the Upper Baker Project will minimize adverse effects on fish and wildlife and should provide additional protection for wildlife resources utilizing the Skagit River flood plain downstream from the project.

Accordingly, we do not object to the Report of the Chief of Engineers recommending that the project be operated as proposed to provide additional flood control storage space.

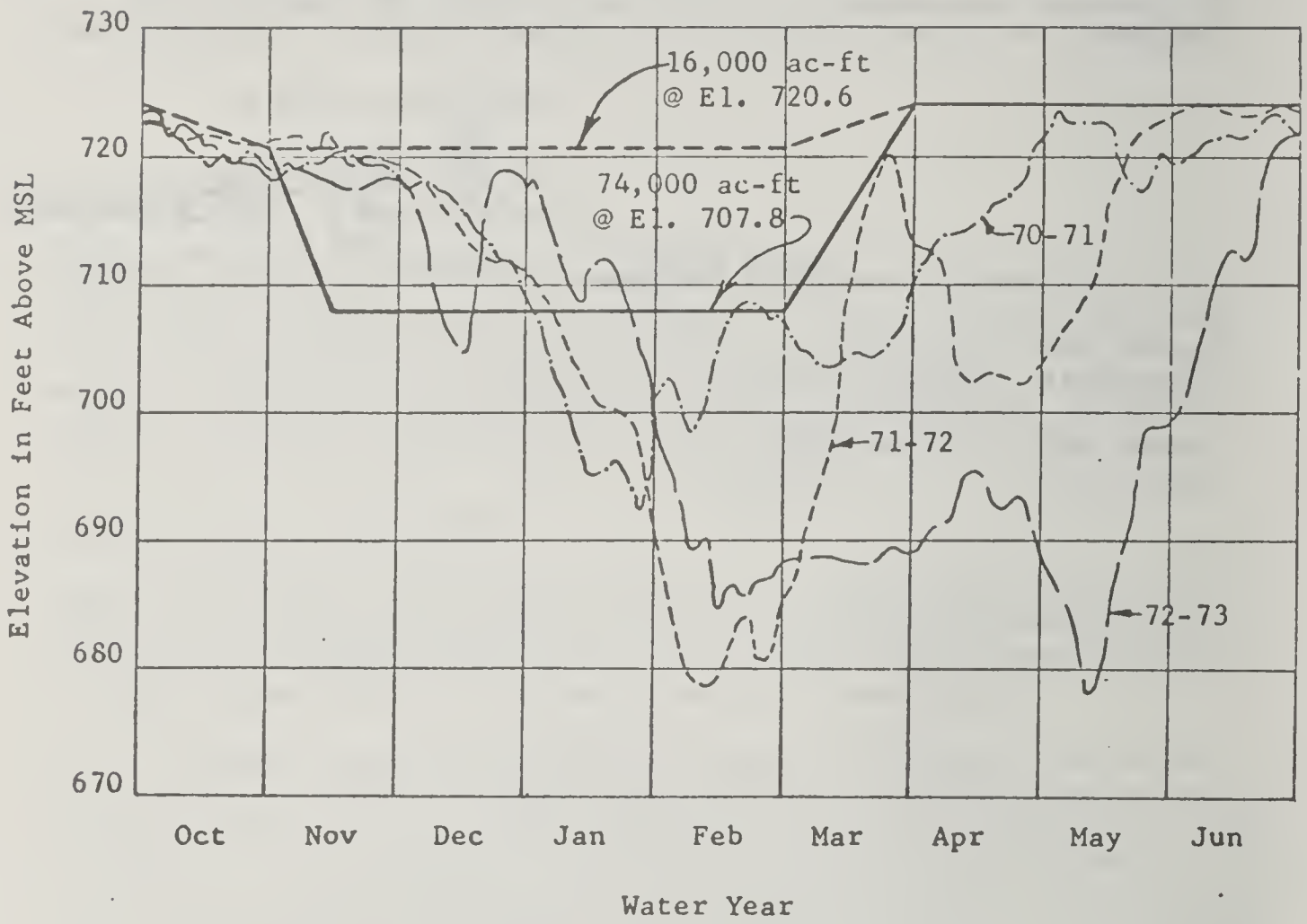
Sincerely yours,

Stanley R. Doremus

Deputy Assistant Secretary of the Interior

W. C. Gribble, Jr.
Lieutenant General, USA
Chief of Engineers
Department of the Army
Washington, D. C. 20314

FIGURE 1



UPPER BAKER PROJECT RESERVOIR ELEVATION

(HISTORICAL DRAWDOWN AND FLOOD CONTROL
RULE CURVES UNDER 16,000 ACRE-FEET (EXISTING)
AND 74,000 ACRE-FEET (PROPOSED CONDITIONS)

PLATE

89-280 O - 77 - 27

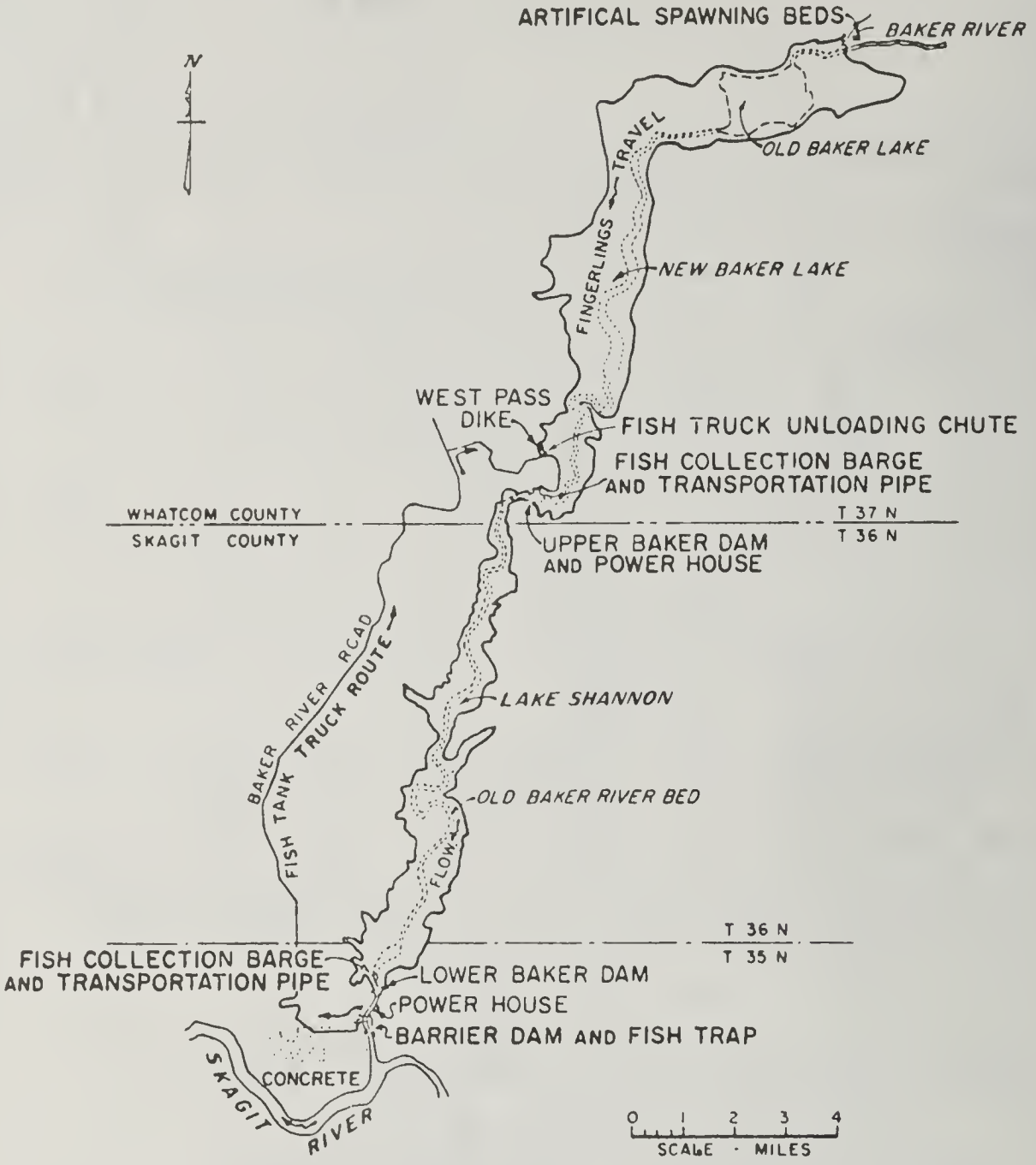

ARTIFICAL SPAWNING BEDS
BAKER RIVER
N
TRAVEL
FINGERLINGS
OLD BAKER LAKE
NEW BAKER LAKE
WEST PASS DIKE
FISH TRUCK UNLOADING CHUTE
FISH COLLECTION BARGE AND TRANSPORTATION PIPE
WHATCOM COUNTY
SKAGIT COUNTY
T 37 N
T 36 N
UPPER BAKER DAM AND POWER HOUSE
BAKER RIVER ROAD
FISH TANK TRUCK ROUTE
LAKE SHANNON
OLD BAKER RIVER BED
FLOW
T 36 N
T 35 N
FISH COLLECTION BARGE AND TRANSPORTATION PIPE
LOWER BAKER DAM
POWER HOUSE
BARRIER DAM AND FISH TRAP
CONCRETE
SKAGIT RIVER
0 1 2 3 4
SCALE · MILES

Plate 2

PUBLIC BROCHURE

ALTERNATIVES AND THEIR PROS AND CONS

ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT

AUTHORITY FOR STUDY: Congress through the Flood Control Act of 1962 authorized a comprehensive water and related land resources study covering the major river basins and island groupings which constitute the Puget Sound region. A comprehensive plan, completed in 1971, called for increasing Skagit River flood control through use of reservoir capacity provided by Puget Sound Power and Light Company's Upper Baker hydroelectric power project in addition to the 16,000 acre-feet of storage space now available during the winter flood season. The detailed feasibility investigation completed by the Corps of Engineers was in followup to the comprehensive study and undertaken under the same authority.

PURPOSE OF BROCHURE: Results of engineering, economic, and environmental impact studies are reflected in this brochure, with information displayed on the alternatives considered. The alternative recommended for implementation by the Seattle District Corps of Engineers is presented along with the basis for this selection.

METHOD (OPEN FISHBOWL PLANNING): Previous drafts of this brochure were distributed to all known interested parties as the study progressed. Their review and comments were invited of the information presented on the alternatives, including social and environmental effects. Views were also sought on the tentative study findings contained in draft #4, distributed in March 1975. All comments received were considered in preparation of the District Engineer's final report.

FRANK J. URABECK
Study Manager
(Telephone 206-764-3611)

SEATTLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
4735 EAST MARGINAL WAY SOUTH, SEATTLE, WASHINGTON 98134

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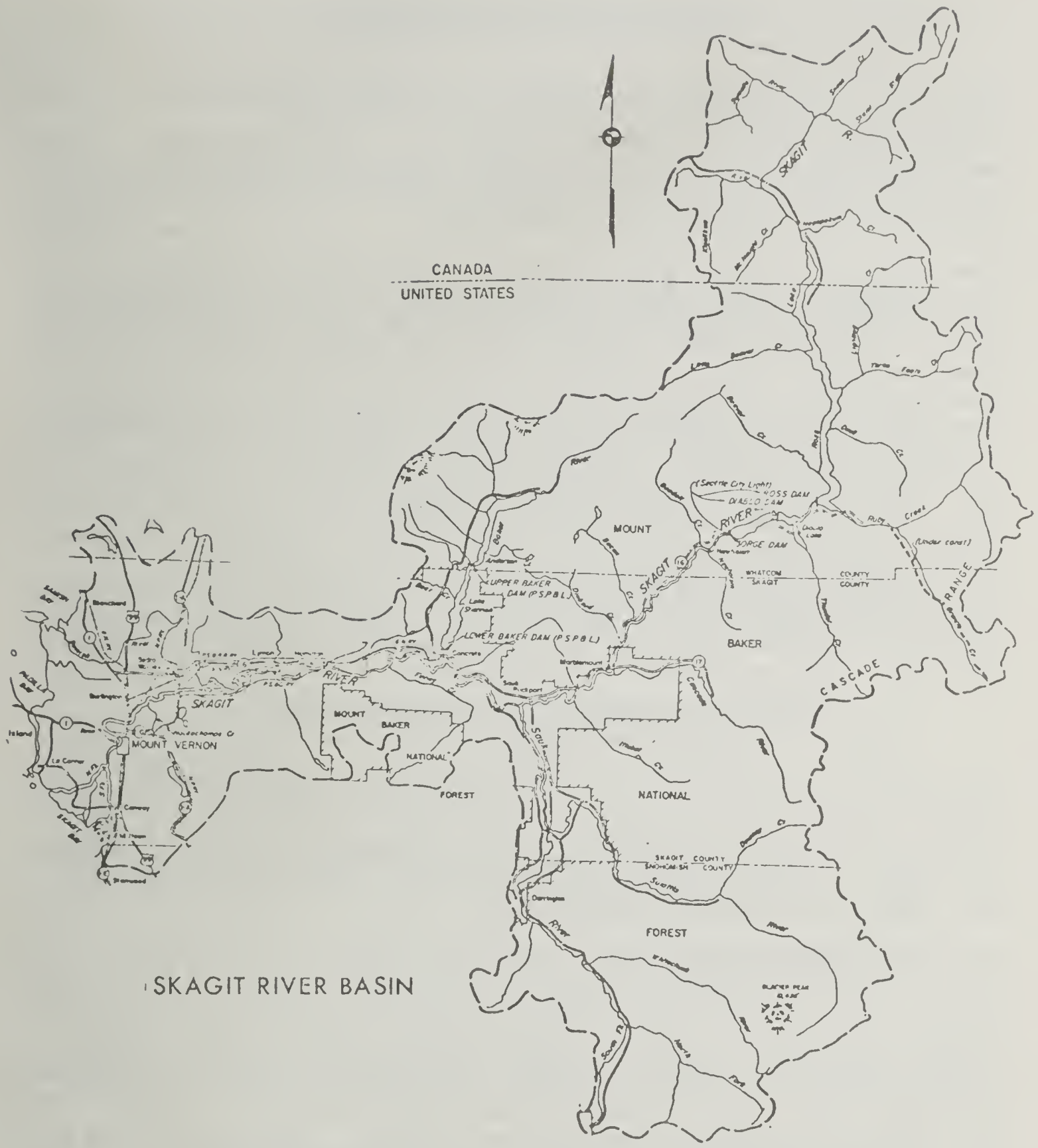

SKAGIT RIVER BASIN

RECOMMENDATION OF SEATTLE DISTRICT

The Seattle District, Corps of Engineers, recommends implementation of Alternative 3, FLOOD PLAIN MANAGEMENT WITH ADDITIONAL FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT, on the basis that this proposal is responsive to locally expressed Skagit River basin needs and is consistent with comprehensive plans adopted by Skagit County and the Pacific Northwest River Basins Commission.

Land use zoning, development restrictions, flood proofing and early flood warning are flood plain management elements of this alternative which would be continued by Skagit County and the State of Washington. Federally subsidized flood insurance would also remain available to county residents. Improved Skagit River flood control below Concrete, Washington, would be achieved through changing the operation of Puget Sound Power and Light Company's (Puget Power) Upper Baker hydroelectric project (see map, page ii). Baker Lake would be lowered to provide a total of 74,000 acre-feet of flood control storage between 15 November and 1 March each year. This includes 58,000 acre-feet, in addition to the 16,000 acre-feet now provided by Puget Power as compensation for natural valley flood control storage lost by project construction. The level of flood protection would be increased for the nearly 100,000 acres of Skagit River lying below the mouth of the Baker River. Flood control use of additional storage space would begin when Skagit River is forecast to reach 90,000 c.f.s. at Concrete (84,000 c.f.s. at Mount Vernon). (See page 16 for more details on alternative 3.)

SUMMARY OF ECONOMIC, SOCIAL AND ENVIRONMENTAL EFFECTS OF RECOMMENDED ALTERNATIVE

The proposed increase in flood control at Upper Baker project would require no construction and only a change in project operation. The environmental effects of the proposed action are anticipated to be minor in most respects. In the discussion of impacts which follows, an attempt was made to isolate as many potential effects as possible, even if they seemed to have only low probabilities of occurring.

Population and Community Growth. The proposed action is not expected to have significant effects on population or community growth within the flood plain. New job opportunities would not be created as a direct result of the project, thereby limiting project effects on future population immigration. Although increased flood control capability has the potential of creating increased development pressure on flood plain lands, especially those close to urban areas and those now protected by dikes and levees, this pressure is expected to be minimal. To the extent that any new lands are brought into intensive development because of added flood protection, a potential for greater personal and economic losses would exist when future major floods do occur. However, the application of stringent flood plain management techniques and flood plain zoning by Skagit County, as called for in the recommended plan, should reduce the likelihood and severity of such losses.

Community Services and Facilities. The cost of flood-related community services and facilities should decrease with implementation of the proposal. A portion of local and state funds which would otherwise be appropriated for flood fighting, rescue and repair may become available for the improvement of other community services and facilities.

Housing. With a decrease in the severity of flooding, homes would incur less damage, thereby allowing the homeowner to invest more in home improvements. As a result, the general quality of housing in the areas affected would increase.

Displaced Persons. Because the proposal would not require construction or acquisition of lands, no displacement of citizens would be required for implementation. The probability of persons being displaced by flooding would be decreased.

Recreation. The proposed action should have only minimal effects on recreational use of the Baker Lake area. Fishing and other recreational uses of the reservoir area, such as camping and picnicking, generally conclude shortly after Labor Day of each year. As the increased drawdown will not begin until 1 November, impacts on lakeshore use for recreational purposes would be limited.

Health and Safety. By decreasing the severity of flooding in the lower Skagit Basin, associated public health problems should decrease. The project is aimed at minimizing the occurrence of severe floods which constitute a public health threat.

Employment and Income. Because the proposed action would not require construction, local employment or income levels would not be impacted to an assessable degree. Temporary disruption of employment due to flood repair would decrease slightly.

Property Values and Tax Revenues. The proposed action would have a slight impact on residential and agricultural property values. Permanent residences and farms damaged by past floods or structures now located in the flood plain could increase in value somewhat. The impacts of flood protection on commercial and industrial property values are expected to be moderate. Property tax revenue may rise to the extent that assessed valuation of all affected property increases.

Local Government Finance. There would be no increase in non-Federal costs associated with this proposed plan. Benefits accruing to local governments would occur as a result of decreases in damage to public facilities.

Business and Commercial Activity. A relatively small portion of land within the flood plain is used for industrial purposes. Because there would be only a partial reduction in flooding frequency, industrial expansion in the flood plain as a result of the project is not expected to occur. The project would, however, provide increased protection to existing industry in the flood plain and thereby reduce potential future flood damages.

Agricultural. The agricultural sector of the economy would realize economic benefits as a result of the proposed action. Average annual monetary benefits accruing to farmers over the 100-year study period are estimated at $338,000. This may induce a minor increase in agricultural development of the study area as lands could be put to more intensive agricultural uses.

Water Quality. Water quality of the Skagit and Baker Rivers is generally regarded as excellent. The Washington State Department of Ecology has classified the Baker River as AA, extraordinary. The Skagit River is classified as A, excellent, from its mouth to river mile 17 (Mount Vernon), and AA, extraordinary, from river mile 17 to the Canadian border. Releases from Baker Lake are expected to increase an average of about 1,900 c.f.s. over existing conditions during the period of additional drawdown between 1 and 15 November of each year. These higher flows should not change the quality of water in the Skagit system now regarded as excellent or extraordinary, and may improve the water quality of the lower reaches of the Skagit River through increased flushing and by maintaining the content of dissolved oxygen.

Flora. Existing vegetation adjacent to the reservoir pool is not expected to be affected by drawdown operations. However, the potential for abrasion of reservoir shoreline may decrease due to the proposed drawdown, and vegetative cover in some areas may then reestablish itself.

Fisheries Resources. Present reservoir drawdown at the Upper Baker Dam results in some sockeye salmon redd losses at higher elevations. Because Baker Lake is nearly full during the start of the spawning season in early fall, some sockeye salmon spawn in lakeshore gravels at elevations above 700 feet and as high as 720 feet. Lakeshore spawning occurs when the artificial spawning beaches are filled to capacity, which happens about once every 2 to 4 years. When lakeshore spawning begins before drawdown, some eggs at higher elevations are left exposed and consequently die. By drafting Baker Lake from elevation 720.6 to elevation 707.8, a rate of about 0.8 feet per day during 1 to 15 November, fish that otherwise might have spawned at the higher elevations would be discouraged from doing so. Because the proposed plan would also result in earlier drawdowns than has been the case in the past, there is a potential for further reductions of present spawning and redd losses. As lake elevations dropped, fish would seek out and spawn in other natural spawning streams.

Fauna. As reservoir levels would not be increased beyond those currently in use, and since no further construction would be needed to implement the proposed drawdown, impacts to wildlife resources are expected to be negligible.

Erosion. Baker Lake would be subject to increased levels of shore erosion due to the exposure of additional land area during the reservoir drawdown period of 1 to 15 November of each year. The drawdown schedule

coincides with the wet season beginning in October and November and lasting from six to seven months. While the climatic and soil conditions of the area would contribute to additional deposition of silt and debris downstream and produce additional scouring of the exposed lakeshore, the overall impacts of these changes in relation to water quality, fish habitat and marine vegetation are expected to be minimal.

Visual Landscape. Earlier reservoir drafting of about 13 feet would expose lake bottom consisting of rotting tree stumps, rock outcroppings and mud flats, sooner than now is the case. The recreational experience of those using the reservoir at these times would be diminished. However, this impact is expected to be minor due to the normally low recreational use of the area during months when reservoir drafting is scheduled to occur.

Power Losses. The power generating capacity of the Upper Baker project would be reduced by changes in operation necessary to provide increased flood control. Power losses would consist of energy losses and capacity losses. Energy loss would result when water which ordinarily would be passed through the power units is routed over the spillway to make storage space available for flood control. Capacity loss would be realized because flood regulation would require reservoir drawdown which reduces hydraulic head available for power generation and results in reduced operating efficiency for generating units. Average energy loss during the flood control storage period is estimated to be 2.681 megawatts or 1.117 megawatts annually. Maximum capacity loss during this period would be 6.3 megawatts. Puget Power would be reimbursed for power losses resulting from the provision of additional flood control storage space through replacement power from the Bonneville Power Administration (BPA). The value of net power losses in terms of revenue foregone by the Federal Government in providing replacement power would be $56,000 annually, based on rate schedules in effect in April 1975. However, BPA itself would be fully compensated in that annual revenues foregone would be considered a nonreimbursable (power) operation and maintenance account of the Chief Joseph Dam, Rufus Woods Lake, Washington, project. Although the proposed operation change would reduce the Northwest's ability to meet projected power demands, this reduction is relatively insignificant.

RATIONALE FOR ELIMINATION OF OTHER ALTERNATIVES

Other alternatives, which were considered during the study, are described below and the reasons given for their elimination. These proposals are discussed in more detail on pages 10 and 12.

Alternative 1 - DO NOTHING. This would have involved relying only on existing flood control facilities, including levees and upstream storage at Ross project for flood protection with no effort made to stem the growth of future flood damages through management practices. Alternative 1 was presented in the first three drafts of the public brochure as a possible option. However, as the State of Washington through its Department of Ecology and Skagit County through its Planning Department are actively engaged in implementing existing and recently adopted State laws which control development in flood hazard areas, this alternative was not given further consideration subsequent to the public meeting held in April 1973.

Also, as shown on page 11, the vast majority of those who responded to previous drafts expressed opposition to this proposal.

Alternative 2 - FLOOD PLAIN MANAGEMENT ALONE. Reliance would have remained on existing flood control facilities; but in addition, management measures including land use zoning, development restrictions, early flood warning, etc., would continue to be employed to reduce the flood damage growth potential in the Skagit Basin. Flood insurance, while made possible by proper local implementation of land use management practices in flood hazard areas, would not reduce damages but merely provides a means of compensation to the affected property owner. Flood plain management is required, however, in order to qualify for Federally subsidized flood insurance. Alternative 2 would be effective in reducing flood damages to new developments but would not significantly mitigate damages to lands and improvements already located on the flood plain. As Skagit County has strongly expressed a desire for higher level flood control and general support has been indicated by responses to past brochure drafts for additional flood protection, this alternative was deemed to be inadequate in itself and not responsive to basin needs. However, flood plain management has been included as part of the selected alternative 3.

SCOPE OF STUDY

Studies were limited to determining the feasibility of providing additional flood control at Upper Baker project consistent with the project's Federal Power Commission (FPC) license. Also considered as an alternative throughout the study was flood plain management alone.

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service late in the study asked that flood control drawdown occur earlier than necessary for flood control in order to benefit Baker Lake salmon production. This earlier drawdown would increase power losses and, therefore, would have to be justified by fishery enhancement benefits. No current provision exists in the FPC license for such a project operation change. Because of this and the lack of data on fish production, the Corps study did not evaluate the early drawdown proposal. However, the Corps of Engineers would support fish and wildlife agencies in any future studies of their proposal, which must be justified on its own merits.

STUDY ACTION TO DATE

Draft brochures were distributed to interested individuals, groups and local, State and Federal agencies in November 1972, April and June 1973, and March 1975, depicting impacts associated with providing additional flood control storage space at Baker Lake. Comments PRO and CON were requested with regard to the alternatives. This is the final brochure containing all comments received on the suggested alternatives. The initial public meeting was held on 25 April 1973 in Burlington, during which the study objectives were outlined. A final public meeting was held on 8 April 1975 in Mount Vernon, during which the recommended alternative was discussed. Detailed engineering, economic, and environmental

impact studies were conducted with input and assistance provided by Skagit County and other State and Federal agencies. Several Studygrams were issued during the course of the study giving information on our progress. Limited distribution of a draft report has been made to the State of Washington, Skagit County and regional offices of interested Federal agencies. Widespread distribution of a draft environmental impact statement took place in February seeking agency and public comments.

FUTURE STUDY ACTION

The District Engineer's report has been finalized, with comments from interested parties considered and incorporated into the report as appropriate. The report, together with this brochure (reflecting comments on draft #4) and the environmental impact statement, will be reviewed by the Corps of Engineers Division Engineer in Portland, Oregon, and the Board of Engineers for Rivers and Harbors and the Chief of Engineers in Washington, D.C. Comments on the recommendations contained in the report will be requested from other Federal agencies and from the State of Washington. These comments will be incorporated into the report, which will then be submitted to Congress.

BACKGROUND

Flood History. The Skagit River valley has a history of winter flooding dating back before 1900. Floodflows have been recorded intermittently since October 1908. Zero damage flow is considered to be 60,000 c.f.s. (measured at Concrete gage). At this discharge, flooding begins between Concrete and Sedro Woolley. However, in the leveed areas below Sedro Woolley, the minimum safe channel capacity is 84,000 c.f.s. Since 1908 this flow has been exceeded 18 times during the winter flood season (October-March). The most recent major flood occurred in February 1951 with a peak discharge of 139,000 c.f.s. at Concrete; 150,000 c.f.s. at Sedro Woolley; and 144,000 c.f.s. at Mount Vernon. The flood remained near its peak for 6 hours at Mount Vernon, a fact which contributed significantly to the severity of the flood damages. During this flood many dikes failed, because they lacked sufficient cross-sectional dimensions to withstand saturation. Tabulated below are flows above 60,000 c.f.s. at the Concrete gage.

30 Nov 1909	260,000	19 Oct 1947	95,200
30 Dec 1917	220,000	27-28 Nov 1949	154,000
13 Dec 1921	240,000	10-11 Feb 1951	139,000
12 Dec 1924	92,500	1 Feb 1953	66,000
16 Oct 1926	88,900	3-4 Nov 1955	106,000
12 Jan 1928	95,500	20 Oct 1956	61,000
9 Oct 1928	74,300	23-24 Nov 1959	89,300
27 Feb 1932	147,000	15 Jan 1961	79,000
13 Nov 1932	116,000	20 Nov 1962	114,000
22 Dec 1933	101,000	22 Oct 1963	73,800
25 Jan 1935	131,000	16 Dec 1966	66,200
28 Oct 1937	89,600	28 Oct 1967	84,200
2 Dec 1941	76,300	1 Nov 1967	64,100
3 Dec 1943	65,200	21 Jan 1968	68,100
8 Feb 1945	70,800	31 Jan 1971	62,200
25 Oct 1945	102,000	16 Jan 1974	79,900
25 Oct 1946	82,200		

Flood Damage Reduction Measures. Existing flood damage reduction measures include a flood forecasting and warning service, flood control storage, levees and flood plain management regulations.

Estimates of impending peak floodflows and expected times of occurrence are prepared by the River Forecast Center in the Portland, Oregon, office of the National Weather Service and disseminated by the Portland River District Office. The River District Office issues emergency and public service teletype bulletins to the National Weather Service office in Mount Vernon, which in turn alerts the county and city officials, newspapers, and transmitting news media. Skagit County Civil Defense Organization is responsible for implementing a flood warning plan.

Ross Dam (see page ii), on the main stem of the Skagit, has 120,000 acre-feet of storage for flood control. This storage was made available in 1953. When flows at Concrete are forecast to reach 90,000 c.f.s., the discharge by Ross Dam is reduced to that required for power generation only. About 16,000 acre-feet of winter flood control storage space is reserved in Baker Lake Reservoir, created by Upper Baker project in June 1959, as replacement for natural valley storage lost when the project was constructed.

Levees extending downstream from Sedro Woolley and sea dikes located on the edge of Puget Sound vary considerably in safe capacity, ranging from discharges expected on the average to recur once every 3 years to discharges expected once every 10 years. The highest level of safe channel capacity is provided along the east bank of Skagit River, protecting Mount Vernon.

A flood plain information report, "Skagit River Basin, Washington," was published by the Corps of Engineers in April 1967. This report has been used by county and State officials to regulate development in flood hazard areas. Legislation providing authority for regulation in these areas

includes the State of Washington Flood Control Zone Act of 1935 and the Shoreline Management Act of 1971. The Skagit River has been designated as Flood Control Zone No. 7 by the Washington Department of Ecology, pursuant to RCW 86.16.

Authorized Corps of Engineers Flood Control Projects.

Levee and channel improvements. The project, authorized by the 1966 Flood Control Act, provides for improving the river channel and raising and strengthening about 34 miles of levees downstream of Burlington. This project is in a deferred status but is expected to be re-examined subsequent to congressional action on the proposed Upper Baker project operation change.

Avon Bypass. This project was authorized by the Flood Control Acts of 1936 and 1966. It includes a diversion channel 8 miles long from near Burlington to Padilla Bay, a 4-mile levee, drainage structures, and widening of the Skagit River for 2 miles. The project is in a deferred status due to Skagit County's inability to assume requirements of local project sponsorship.

Ongoing Related Studies.

Water Pollution Control and Abatement Plan. Under Federal law, Skagit County, like all other parts of the country, is required to submit a water pollution control and abatement plan, in order to qualify for grants for water and sewer improvements. The Department of Ecology is monitoring this study as it is carried out by county and municipal agencies.

National Wild and Scenic River System. The U.S. Forest Service is in the process of finalizing its report on a study of the Skagit River that was undertaken to determine if the Skagit and several of its tributaries meets the requirements for inclusion in the National Wild and Scenic River System. Tentatively, the Forest Service is recommending that the Skagit River from Sedro Woolley to Bacon Creek be classified "recreational" and the entire length of the Cascade, Sauk and Suiattle Rivers be classified "scenic." Alternative 3, as described on page 1, is entirely consistent with these classifications.

Washington Water Resources Program. Under its Water Resources Program, the Department of Ecology is responsible for determining the existing situation, problems, prospective needs, and alternative solutions relative to all water resource matters throughout the State. Much of this activity will be accomplished by meetings with interested citizens and public hearings in the various river basins. Work was initiated in July 1971, and completion of the initial studies is scheduled for 1977.

Land Use Plans.

State Shoreline Management Act of 1971. Skagit County completed an inventory of all affected lands in October 1972, in compliance with the State Shoreline Management Act of 1971. The county shoreline master program is scheduled for publication and submission to the Department of Ecology by September 1975.

Comprehensive Land Use Plans. The Skagit County Planning Department is also reviewing the existing Comprehensive Land Use Plans to determine what changes, if any, are desirable. These plans are available for consultation at the Skagit County Courthouse Annex.

ALTERNATIVE 1

DO NOTHING

DESCRIPTION: Reliance would remain on existing flood control facilities, including levees, dikes and current flood control storage at Ross and Upper Baker projects, with no effort made to stem the growth of future flood damages through management practices (see map, page 15, for flood plain).

EFFECTS:

Plants and animals. Further loss of river habitat.

Water quality. Some degradation.

Recreation. Increased recreation homesite development in flood plain.

Land use. More intensive development expected than would be the case with flood plain regulations.

People. Present population trends would continue.

Flood damage. The approximately 100,000 acres of Skagit River flood plain downstream of the mouth of Baker River, near Concrete, would continue to be subject to the current level of flood risk, with future damages expected to be approximately 17 percent greater over the same economic life as alternative 3 than with an adequate flood plain management program.

ALTERNATIVE 1
Do Nothing

UPPER BAKER

PROS	CONS
PLANTS AND ANIMALS	
1. No impact. Would have no additional impact on fish and wildlife recreation. (Dept. Game, F&WS)	1.
2.	2. Siltation and turbidity. Temporary water siltation and turbidity would continue during each successive flooding and runoff condition. (F&WS)
RECREATION	
3. New recreational or access benefits would violate the spirit or the Scenic Highway and National forest. (BP)	3. No new recreational or access benefits would result. (F&WS)
LAND USE	
4. Sediment deposited. Flooding of Skagit and Nookachamps leaves beneficial sediment. (DD#21)	4. Erosion. Erosion upstream would continue to increase. (LPC)
5. Applies to only some lands. This alternative would apply only on lands outside of existing flood control zones. (Dept. Ecol.) Lack of flood management is the easiest way to insure that the flood plain remain in agricultural and open space use. (BP)	5. Uncontrolled development. Does not provide management guidelines and encourages sporadic development. (Sierra)
PEOPLE	
6.	6. Only a matter of time before a major Skagit River flood results in substantial loss of life and property. Presently extensive areas of nondiked lands are inundated periodically. (SWCD)
FLOOD DAMAGE	
7. Diking helps. Since diking in diking district No. 17 was raised, trees were removed, and bank riprapped after flood of 1951, there has been no trouble. (SF)	7. Impossible solution. This area is already in a flood control zone, and Alternative 2 is already in effect. (L. St. John)
8.	8. Studies should be made. Flooding problem is due to the Sauk and Suiattle Rivers. (DD#14) Studies should be made on how to minimize flooding in the Skagit Valley. (SVG) Flood control is a must. (SE)
9.	9. Lower valley unprotected. Offers no protection to lower valley if damage occurs. (Dept. Ecol., Dept. Game, LPC, F&WS)
ECONOMICS	
10.	10. Costly. Costs of doing nothing would exceed benefits. (DD#21) All that is needed is to clean up the river, especially in the vicinity of the Burlington Northern Bridge between Mt. Vernon and Burlington, and make inexpensive commonsense repairs. (DD#14)
OTHER COMMENTS	
11.	11.

NOTE: Sources of comments, together with abbreviations used, are listed at the end of this brochure.

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ALTERNATIVE 2

FLOOD PLAIN MANAGEMENT ALONE

DESCRIPTION: No additional flood control structures would be constructed. Existing levees would be maintained and Ross and Upper Baker storage projects continued to be operated as they have in the past. (See map, page ii.) In addition, the following specific nonstructural measures would be relied upon to lessen the growth in flood damage potential.

a. The existing warning system would continue to provide residents of the Skagit Basin advance notice of impending floods in sufficient time to permit them to evacuate some personal property. Flood forecasts are issued by the U.S. Weather Bureau and broadcast by radio and television stations with Skagit County Civil Defense Office responsible for alerting people to the danger of impending floods.

b. Flood proofing would be applied to all future development in the flood plain. In most cases, this would involve placement of fill and constructing the ground floor of structures above the 100-year flood level. The majority of existing developments in flood hazard areas are not expected to be flood proofed due to the expense involved and the availability of relatively inexpensive subsidized flood insurance.

c. New construction would be severely restricted if not precluded in designated floodway areas.

d. The flood insurance program, established under the Housing and Urban Development Act of 1968, as amended in 1973, would be used to make available Federally subsidized flood insurance. Skagit County is presently qualified for this insurance, which applies to one-to-four family dwellings, properties occupied principally by small business, and to the contents of properties of these types. Cropland, industry, and large businesses are not eligible for flood insurance. Other losses, such as interruptions to transportation, also are not covered.

ANNUAL COSTS:

Federal - USCE and HUD	$248,000	(flood information & insurance)
State of Washington	8,000	(flood plain zoning & permits)
Skagit County	20,000	(flood plain zoning & permits)
Individuals	65,000	(flood proofing & insurance)
Total	$341,000	

EFFECTS:

Plants and animals. Existing trends would continue.

Water quality. Existing trends would continue.

Recreation. Existing trends would continue.

Land use. Conversion of agricultural and open space lands to intensive uses would be less than under alternative 1.

Flood damage. Flooding would continue; however, damages to future developments in flood-prone areas would be lessened due to flood proofing, advanced flood warning, and restrictions designed to keep development out of extreme flood hazard areas.

Transportation. Road, highway, and rail traffic would still be subject to disruption during floods.

ECONOMIC ANALYSIS:

Average annual benefits	$1,058,000	(flood damage reduction & flood insurance payouts)
Average annual costs	$341,000	
Benefit-cost ratio	3.1	

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ALTERNATIVE 2

UPPER BAKER
Flood Plain Management Alone

PROS	CONS
PLANTS AND ANIMALS	
1. Good for all. Most favorable and beneficial to fish, wildlife, water quality, and recreation. (F&WS)	1.
WATER QUALITY	
2.	2. Erosion and sedimentation. The cause of erosion at the upper part of the river and sedimentation at the lower part must be attacked at its source. (LPC)
RECREATION	
3. Keeps recreational potential. Preserves recreational potential of lower valley (Dept. Game) and has less effect on environment. (Sierra)	3.
LAND USE	
4. A master basin control plan. There are integral elements of the total basin program and should be continued and expanded where practical (Dept. Ecol.), and incorporated into a master control plan. (LPC) Most realistic plan (DD#12, R. Hammond), and already in effect under current legislation. (L. St. John) It is a supplement to Alternative 3. (MBNF)	4.
5. Commercial and industrial development. Precludes extensive commercial and industrial developments within flood plain, thus preserving open spaces important for recreation and wildlife (Dept. Game, F&WS), and encourages use of alternative areas above the flood plain. (SWCD, BP) Zoning or outright acquisition of a corridor within the flood plain perimeter for recreational access would allow expansion of fish and wildlife opportunities for benefit of the public (F&WS); also should build more salmon hatcheries so there will be more fish in Skagit River. (DD#21)	5. Decreased use of valley land. (BP) Agricultural operations would be discouraged. (F&WS) (DD#21)
6. Flood management. Provides management planning for flood plain and encourages land uses compatible with flooding. (Sierra) The more secure the flood plain becomes, the more intensive type of land use can be expected, i,e. urban encroachment on farmland. (BP)	6.
PEOPLE	
7. Investors will be warned. Should serve as a warning to future investors that there is a potential flooding problem. (SWCD)	7.
8.	8. Insurance. Insurance should be considered as a precautionary measure (Dept. Ecol.), and should not be expected to replace good judgement in locating structures. (SWCD)

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AS FACTUAL COMMENTS ARE DESIRED RATHER THAN VOTES FOR OR AGAINST THE ALTERNATIVE

UPPER BAKER
Flood Plain Management Alone

	PROS	CONS
	PEOPLE (Con.)	
9.	Small governmental subdivisions are subject to pressures, and decisions made under these conditions may not be best in the long run. (SWCD) Involves political decisions difficult to Implement. (MBNF)	9.
10.		10. An inadequate solution. (SE) Flood plain use accounts for only a small percentage of the total damage potentials. (Dept. Ecol.)
11.	Warning system. An improved warning system is needed. (SECD, #12 SW, #12 MV, #21)	11. May be poor dike case. Might cause less careful dike maintenance, thus increasing potential dangers. (BP)
	ECONOMICS	
12.	Least costly solution. (L. St. John)	12. Costs would exceed benefits. (DD#21)
	OTHER COMMENTS	
13.		13.

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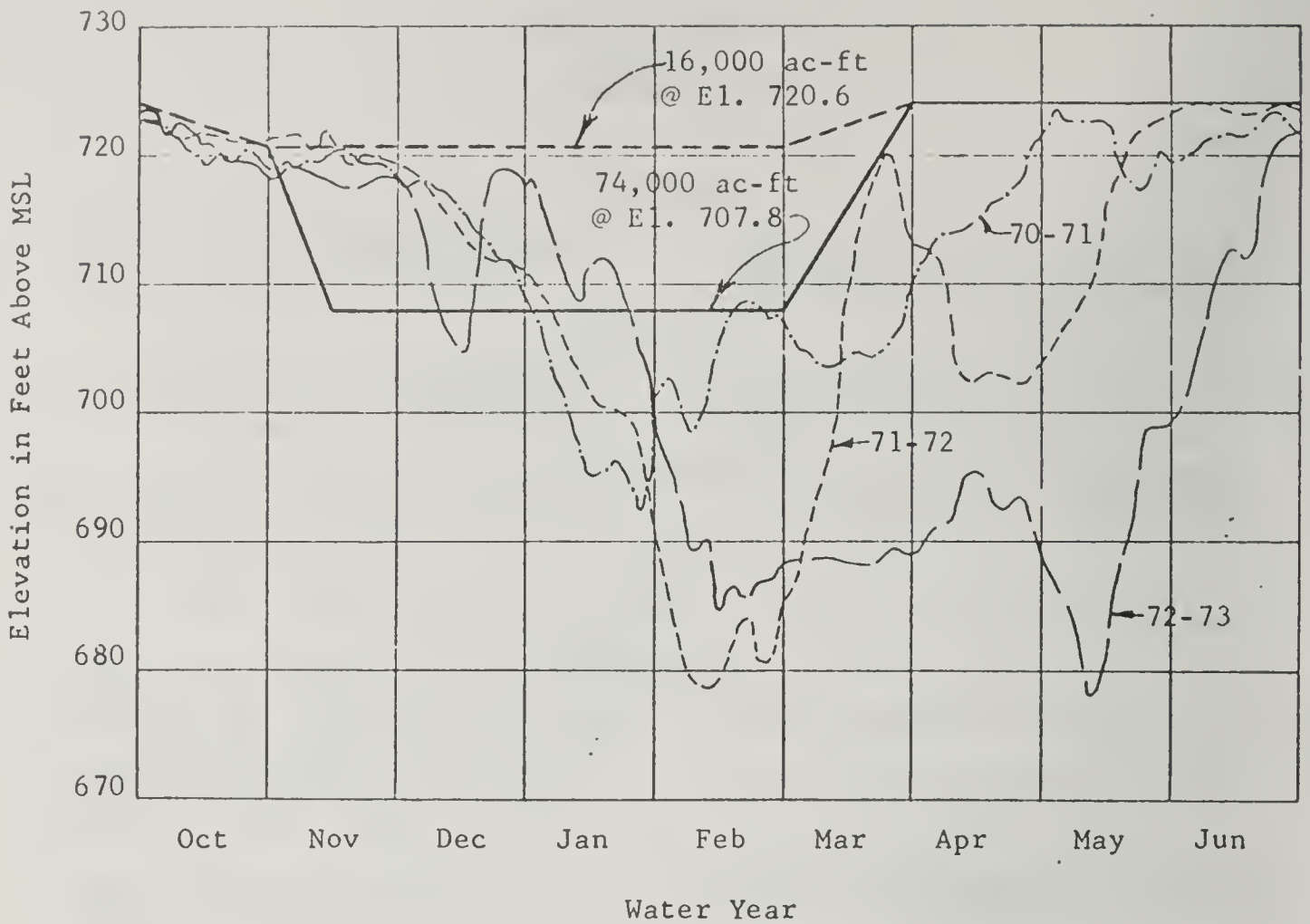

UPPER BAKER PROJECT RESERVOIR (BAKER LAKE)

(HISTORICAL DRAWDOWN AND FLOOD CONTROL
RULE CURVES UNDER 16,000 ACRE-FEET (EXISTING)
AND 74,000 ACRE-FEET (PROPOSED CONDITIONS)

ALTERNATIVE 3

FLOOD PLAIN MANAGEMENT WITH ADDITIONAL
FLOOD CONTROL STORAGE AT UPPER BAKER PROJECT

DESCRIPTION: Flood plain management measures defined under alternative 2 are included in this proposal, which calls for a change in operation of the existing Upper Baker hydroelectric project, owned and operated by Puget Sound Power and Light Company. The Upper Baker project currently provides 16,000 acre-feet of flood control storage, as compensation for natural valley storage lost due to construction of the project. The Federal Power Commission project license allows up to an additional 84,000 acre-feet of flood control storage to be utilized at the project, provided that Puget Power is satisfactorily compensated for the attendant reduction in power production capability. The following alternative volumes of increased storage were examined:

Storage Space (acre-feet)		Minimum Flood Control
Additional	Total	Pool Elevation
84,000	100,000	701.4
58,000	74,000	707.8
50,000	66,000	709.8
40,000	56,000	712.1

The recommended plan calls for an additional 58,000 acre-feet of storage space to be provided by 15 November. The pool would be kept below elevation 707.8 from 15 November, except during an actual flood event, until 1 March. Use could be made of the reservoir's full capacity for hydroelectric power generation by 1 April. See page 15 for the existing and proposed flood control rule curves, including actual drawdowns for 1970-1973.

WITHOUT FLOOD PLAIN MANAGEMENT BENEFITS

IMPLEMENTATION COSTS:

Federal - $21,000 - Preparation of reservoir regulation manual and negotiation of power loss evaluation agreement.

AVERAGE ANNUAL COSTS:

Actual

Federal - $68,000 - Federal power revenues foregone in providing replacement power from the Federal system to Puget Power and allowance for administrative costs associated with Upper Baker project flood control operation.

Economic

Federal - $434,000 - Alternative cost of replacement power and average annual administrative costs associated with additional flood control at Upper Baker project.

AVERAGE ANNUAL BENEFITS: Flood damage reduction - $1,127,000

BENEFIT-COST RATIO: 2.6 (economic)

WITH FLOOD PLAIN MANAGEMENT BENEFITS

AVERAGE ANNUAL COSTS: $775,000

AVERAGE ANNUAL BENEFITS: $2,185,000

BENEFIT-COST RATIO: 2.8 (economic)

EFFECTS:

Plants and animals. Reservoir fishery would not be adversely affected. Additional water, released from the Upper Baker project, during flood control drawdown, would augment Skagit River flows during salmon spawning.

Water quality. Lower reservoir levels during the period of heavy winter rains could increase siltation in Baker Lake and result in higher turbidity downstream.

Recreation. Downstream Skagit River sport fishery could be improved by low-flow augmentation.

Land use. The increased flood protection provided by this alternative would not be sufficient to allow relaxation of current restrictions on intensive developments in flood hazard areas. Therefore, no effect on land use is expected.

Flood damage. Additional flood protection would be provided for nearly 100,000 acres of Skagit River flood plain located below the mouth of Baker River, near Concrete.

Power lost. Hydroelectric power generation capability at the Upper Baker project would be reduced due to the requirement for a lower pool during the winter flood season. This could contribute to power shortages in the Pacific Northwest. However, the relatively small amount of power involved is not expected to significantly impact the overall system. Puget Power would receive replacement power from the Bonneville Power Administration.

ALTERNATIVE 3

Flood Plain Management with Additional Flood Control Storage at Upper Baker Project

PROS	CONS
PLANTS AND ANIMALS	
1. Field inspection indicates that this is not a problem. (C of E) Increased flood control storage in Baker Lake will not result in additional impact on the salmon fisheries resource. (Dept. Fish)	1. Fish will be affected by drawdown. Low drawdown would trap fish fry in pits at upper end of lake, exposing them to predation and other losses. (NMFS) Scheduled pool elevation would result in downstream migrants escaping through turbines (F&WS, NMFS).
2. Spawn in Channel Creek. The proposed drawdown might prevent the sockeye from spawning on the subsequently dewatered portion of the beaches where their eggs are killed. As result, the fish will seek out and successfully spawn in Channel Creek. (Dept. Fish, NMFS) Field inspection indicates that this is not a serious problem. (C of E)	2. Access to spawning may be a problem. Increased drawdowns could adversely affect accessibility of spawning streams. (F&WS, BRRS) Would eliminate or expose shoreline spawning habitat now used by sockeye salmon. (F&WS)
3. Drawdown times different. Begin drawdown about October 30, end of fishing season, not October 1. (BRRS, Hesseldahl) Suggest after Labor Day to October 1. It will help sockeye to spawn somewhere else. (NMFS) Starting after Labor Day will have minimal impact on recreational angling in Baker Lake. (SWCD)	3. _____
WATER QUALITY	
4. No significant impacts on water quality due to the proposed project. (EPA)	4. Siltation and turbidity problems. Holding the reservoir at a low level, especially during the winter months, would expose the shoreline to heavy rains and create a siltation problem and increased turbidity. (F&WS, NMFS)
RECREATION	
5. No effect on recreation. If drawdown occurs in the fall, should not have adverse effect on summer recreation. (MBNF)	5. Drawdown effect on recreation. Need to evaluate recreational impacts due to reservoir drawdown. (Dept. Ecol.) Might affect fishing access in spring. Would decrease recreational and scenic values of Baker Lake (Sierra Club). Further drawdown of the reservoir may cause an adverse effect on recreational potential of the basin. (BRRS)
LAND USE	
6. Important for land-use program. Should be considered an integral component of the program for the entire basin. (Dept. Ecol.)	6. _____
7. Due to only partial reduction in flood hazard and restriction of flood plain management, land use should not change. (C of E)	7. Could result in more intensive use of flood plain with resulting loss of open space anc green belts. (WEC)
8. Land subject to flooding could eventually be lost due to erosion. (DD#21) Nookachamps area needs protection. (B. Lundvall)	8. In case of Nookachamps area, flooding is beneficial. (P. Wilcox)

NOTE: Sources of comments, together with abbreviations used, are listed at the end of this brochure.

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Flood Plain Management with Additional Flood Control Storage at Upper Baker Project

	PROS		CONS
	PEOPLE		
9.	Will protect farmlands. Flood control including upriver storage is essential for protection of farmland and existing farm and residential structures in the existing flood plain. This is included in District long-range program. (SWCD, S. Mengler)	9.	Diking. It would be better to improve dike. (BP)
10.	_____	10.	Electric supply reduced. Releases available electric supply at time when need is greatest. (SE)
	FLOOD DAMAGE		
11.	Support flood protection. Strongly support this flood protection. (SE, BPW, #12 MV, #17, #20, DD#13, #15, DD#21, Yeoman, Hesseldahl, SEC.) We would favor even this small amount over nothing. (SWCD) Represents some positive control on flooding. (MBNF) Would provide partial relief. (IPC, Hamilton)	11.	Not enough protection. Only corrects about 8 percent of the total flood damage of the basin. (Dept. Ecol.) Watershed above Upper Baker includes less than 7 percent of area of the Skagit at Mt. Vernon and about 10 percent of runoff volume. This degree of control would be small under severe conditions. (SWCD)
12.	Storage will increase. The additional flood storage could make the difference between the disaster or high river stage. (PNWA) Additional flood storage at Upper Baker will not adversely affect the environmental values of Skagit Valley. (EPA) It is only a start on the overall control program for Skagit, and its benefits will more than justify the costs. (SWCD)	12.	_____
13.	Favor Alternative 3 with improved warning system. (Hamilton)	13.	_____
14.	Flood plain development. Flood control storage in Baker Lake, combined with flood plain management, offers the most acceptable plan. (SWCD)	14.	False sense of security. Encourages development of flood plain for uses incompatible with flooding. (Sierra) Would create a false sense of security which could induce continued building in floodprone areas. (R. Hammond, SWCD)
15.	Reduces peak flows. Present operation of Baker Dam has already helped to reduce peak flows (SVG), and flood storage in Baker Lake would be of great benefit to the lower valley. (SC)	15.	Impact on environment. Doubtful that changed reservoir operation would provide noticeable flood control benefits, while contributing to substantial environmental damage and degradation. (F&WS)
16.	With the additional flood storage, the authorized levee project will provide adequate protection. (PNWA) With existing storage projects and good dikes below Sedro Woolley, ample flood insurance will exist. (P. Wilcox)	16.	_____
	ECONOMICS		
17.	No large capital costs. Can be achieved without large capital costs. (Dept. Ecol., Hamilton) Cost in relation to benefits appears favorable. (SWCD)	17.	Questionable whether costs would be justified. (SE) A very expensive project (BP), and involves recurring annual cost. (MBNF)
18.	Additional flood control at Baker would hold damages to a minimum. (DD#21)	18.	_____

NOTE: Sources of comments, together with abbreviations used, are listed at the end of this brochure.

STATEMENTS BOTH PRO AND CON ON EACH ALTERNATIVE ARE ENCOURAGED FROM AGENCIES, GROUPS AND INDIVIDUALS AS FACTUAL COMMENTS ARE DESIRED RATHER THAN VOTES FOR OR AGAINST THE ALTERNATIVE

Flood Plain Management with Additional Flood Control Storage at Upper Baker Project

	PROS	CONS
	ECONOMICS (Con.)	
19.	Economic analysis has determined benefits derived from additional storage in Baker Lake to be economically justified. (C of E)	Negative benefits. Reduced available electrical supply, little change in flood occurrence, encourages development of flood plain, trap fish during drawdown. Appears to offset benefits of additional storage. (BPC)
20.	_____	Flood insurance is available without any increased storage in Baker. (BPC)
	OTHER COMMENTS	
21.	Power losses to Puget Sound Power and Light would be replaced in kind from other sources. (DOE) Power loss compensation tentatively worked out between Puget Power, BPA and C of E. No local funding required (C of E).	Would have no influence locally, but would be a minor regional power loss. (DOE, SP) Reduction of hydro capability would have to be replaced by thermal generation. (BPA) Problem exists of reimbursement for power loss and method of dividing costs. (LPC) Districts cannot afford costs of this. (#12 SW, #12 MV)
22.	Baker Lake would not be lowered below current fall levels until November, long after recreation season is ended. (C of E)	Tarrs Baker Lake Resort should be reimbursed for loss due to lowering the Baker Lake.
23.	Alternative 3 is well formulated and is supported by our department, which acts as the representative of the Governor's office on these matters. (DOE)	_____
24.	Power loss estimates are reasonable and we endorse alternative 3. (PSP&L)	_____
25.	Skagit County agrees to implement flood plain management aspects of recommended plan. (SC)	_____

NOTE: Sources of comments, together with abbreviations used, are listed at the end of this brochure.

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AGENCIES AND GROUPS CONTRIBUTING FACTS TO THE STUDY

	Organization	Contact	Provided facts for or commented on brochure dated: April 73	June 73	March 75	June 75
	LOCAL					
	Skagit County					
SE	Engineer	L.H. Johnson	X	X		
SP	Planning Dept.	R. Schofield				
SF	Flood Control Council	E. Hanson	X			
SWCD	Soil & Water Conservation District	R.J. Hulbert	X	X		X
CES	Cooperative Extension Service	W.V. Gray			X	
SFB	Farm Bureau					
SPUD	Public Utility District					
SC	Commissioner	H.A. Miller		X		X
	Burlington					
BP	Planning Commission	F. Lubbe	X		X	
BPW	Public Works	A. Lucas	X			
	Sedro Woolley					
	Mt. Vernon					
	Lyman					
LPC	Planning Commission	B. Coggins				
PSP&L	Puget Sound Power & Light Co.	J. Finnegan		X	X	X
	Whatcom County	W.L. McIntyre		X		
	Hamilton	E. Hooper		X		
	Dike Improvement Districts					
#12SW	D.D. #12, Sedro Woolley	G.D. Mapes	X			
#12MV	D.D. #12, Mt. Vernon	L. Ivey	X	X		
#21	D.D. #21	A. Bell	X			
#2	D.D. #2, Mt. Vernon	L. Hughes	X			
#17	D.D. #17	E. Hanson		X		
#15	D.D. #15	R. Reedy, P. Summers, E. Summers		X		
#20	D.D. #20	R.G. Thompson		X		
	Drainage Districts					
DD#21	D.D. #21, Mt. Vernon	P.O. Wilcox	X	X	X	
DD#14	D.D. #14	J. Ball, L.Ovenell	X			
DD#13	D.D. #13	G. Dynes		X		
	STATE					
DOE	Dept. Ecology, Olympia	F. Hahn, K. Kauffman	X			X
	Dept. Fish	Don Moos	X	X	X	
	Dept. Game	J. Ward, E. Reade Brown	X		X	
DNR	Dept. Natural Resources					
PCA	Planning & Community Affairs					
C&ED	Commerce & Economic Development					
NWAPA	N.W. Air Pollution Authority					
SEC	State Ecology Commission					
	FEDERAL					
SCS	Soil Conservation Service, Spokane	L.F. Kehne	X			
MBNF	Mt. Baker National Forest	D.E. Allen	X			
BRRS	Baker River Range Station	R.L. Novy		X		
F&WS	Fish & Wildlife Service	N. Brown	X		X	
BuRec	Bureau of Reclamation					
BPA	Bonneville Power Administration	F.G. Gilkey		X		
NMFS	National Marine Fisheries Service	F. Cleaver	X	X	X	
NWS	National Weather Service					
FPC	Federal Power Commission	M.F. Thomas	X			
EPA	Environmental Protection Agency	C.E. Veirs Hurlon C. Ray	X		X	
	MISCELLANEOUS ORGANIZATIONS					
SVG	Skagit Valley Grange #620, Mt. Vernon	N. McRae	X			
Sierra	Sierra Club	D. Osterhold	X			
WEC	Washington Environmental Council					X
SEC	Skagit Environmental Council	M. Yeoman				X
LWV	League of Women Voters					
PNWA	Pacific N.W. Waterways Association	G. Dynes		X		
	INDIVIDUALS					
	Hammond, R.K., Tacoma		X			
	Kalt, J.E.			X		
	L. St. John		X			
	Yoeman, Margaret					X
	Hesseldahl, Norman					X
	Wilcox, Paul O.					X
	Lundvall, Bob					X
	Mengler, Stephen					X

PLAN FOR PUBLIC INVOLVEMENT
ADDITIONAL FLOOD CONTROL AT UPPER BAKER PROJECT

1 JULY-SEPTEMBER 72 Original alternatives developed by Corps of Engineers and local interests. Public brochure draft #1 prepared.	2 OCTOBER 72 Brochure draft #1 with all alternatives mailed to interested parties with their comments requested.	3 NOV 72 - FEB 73 Public comments on alternatives evaluated. Alternative 3, Flood Plain Management with Additional Flood Control Storage at Upper Baker Project tentatively selected as best alternative.
4 MARCH - APRIL 73 Draft #2 of brochure prepared of all alternatives with PROS and CONS and announcement of apparent best alternative. Brochure draft #2 mailed to interested parties and public meeting announced. Began detailed studies of Alternative 3.	5 APRIL 73 Public meeting by Corps of Engineers. Public comments solicited on brochure draft #2. Alternative announced for detailed study.	6 MAY - JUNE 73 Refined and revised brochure draft #3 and mailed to interested parties, with request for comments.
7 JULY 73 - MARCH 75 Continued detailed study of Alt. 3. Study Gram reporting on study status mailed in Nov 73 & Jun 74. Prepared & distributed draft report for limited review. Brochure draft #4 distributed. Final public meeting announced.	8 APRIL 75 Final public meeting held by Corps of Engineers, brochure draft #4 and results of detailed studies discussed and public views received. Agency review comments on draft report and EIS received.	9 MAY-- JUNE 75 Finalize District Engineer's report. Refined and revised final brochure to reflect public review and comments.

ADDITIONAL FLOOD CONTROL
AT UPPER BAKER PROJECT

Your comments (PRO or CON) on the alternatives listed in the brochure will be appreciated as well as any other comments you may wish to make. Please return this sheet by folding and stapling, and placing in the mail. No postage is required.

ALTERNATIVE	PRO or CON

GENERAL COMMENTS

NOTE: This tear-off sheet was provided with public brochure draft #4.

Thank you for commenting!

STATEMENT OF FINDINGS
Additional Flood Control
at Upper Baker Project
Skagit River Basin, Washington

As District Engineer, Seattle District Corps of Engineers, it is my duty in the role of responsible Federal official in the case of the proposed action to reduce flood damages by additional flood control at Upper Baker Project, Skagit River Basin, Washington (hereinafter referred to as recommended plan), to review the proposal in light of new policies, draw conclusions, and make recommendations to my higher authority. In this respect I have reviewed and evaluated, in light of the overall public interest, the documents concerning the proposed action, as well as the stated views of other interested agencies and the concerned public, relative to the various practicable alternatives for reducing flood damages in the Skagit River Basin, Washington. The possible consequences of these alternatives have been studied according to environmental, social well-being, and economic effects, including regional and national development and engineering feasibility.

The Seattle District has taken all reasonable steps to assure that the revision of the environmental statement contains all identified environmental consequences of the proposed action in accordance with the National Environmental Policy Act of 1969, and the report and the statement have been revised to reflect the environmental concerns. The draft of the revised environmental statement was made available to governmental agencies, groups, and the general public. In preparation of the final revised environmental statement, careful consideration was given to comments received from other agencies, groups, and individuals and, where appropriate, the environmental statement was changed.

In evaluation, the following points were considered pertinent:

Environmental considerations. The recommended plan (Environmental Quality Plan) would maintain and possibly enhance environmental values in the Skagit River Basin. Only a change in Upper Baker Project operation would be needed, with no significant environmental effects expected. Possibly some limited improvement in sockeye salmon production over existing conditions would be gained incidental to flood control drawdowns. Adult fish may be discouraged from spawning in the lake bottom, which is later exposed. Flood plain management aspects of the plan should help insure that open space and green belt areas are retained in the Skagit Valley. Flood plain management alone, while helpful in steming the growth of flood damages and preserving the natural environment, would not have the attributes that the recommended plan has.

Social well-being considerations. Skagit County, through its Board of County Commissioners, has long sought to reduce the flood damage potential in the Skagit River Basin through the affirmative action, including implementation of effective flood plain management practices. Their desire, which I have taken into careful consideration, is to reduce the flood threat and thereby improve the personal welfare, including health, safety, and peace of mind of citizens residing or owning property in the flood plain. In my opinion, the recommended plan is superior to all other alternatives considered in meeting the objectives of preservation and enhancement of the social well-being of the people.

Economic considerations. The recommended plan is also the National Economic Development Plan in that it would provide greater net benefits than other alternatives considered. The storage volume and operating scheme selected for the recommended plan are consistent with the objectives of providing reliable and economically justified increased flood control for the Skagit River Basin.

Other public interest considerations. The provision of additional flood control space at the Upper Baker Project would require no modification of existing project facilities and, therefore, not place any demand on study area nonrenewable resources. Also, implementation of the recommended plan would allow further planning to proceed in the form of preconstruction studies of the previously authorized Skagit River levee and channel improvement project. The latter is very much wanted by Skagit County. Together with additional flood control storage at Upper Baker Project, the minimum level of flood protection in the lower Skagit Valley would be increased from the current 3 years average recurrence interval to about 11 years for agricultural areas.

I find that the proposed action is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives; that, wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternative courses of action which would achieve the congressionally specified purposes; that, where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations of national policy; that, the recommended action is consonant with national policy,

statutes, and administrative directives; and that, the total public interest would best be served by the implementation of the recommendations.

Raymond D. Zumwalt 10 June 75
District Engineer Date

I have reviewed the Statement of Findings and concur with the recommendations of the District Engineer.

Wesley E. Peel 8 Aug 75
Division Engineer Date

I concur in preceding Statement of Findings.

Drake Wilson 10 Sept 75
DRAKE WILSON DATE
Brigadier General, USA
Deputy Director of Civil Works

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